THE

ELECTRICAL REVIEW.

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J. A. BERLY'S

UNIVERSAL ELECTRICAL DIRECTORY

For 1892,

IS NEARLY READY.

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SHOULD BE SENT IN AT ONCE.

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HALF TRUTHS AND WHOLE TRUTHS.

IN the "Town Councillors'" columns of a contemporary we observe the following editorial paragraph:—"My experience is that the newly-formed Electric Lighting Committees throughout the country generally consist of the picked men of the Town Council, and I am sure that they would warmly welcome the guidance which *Lightning* is able to give them on the subject to which their attention has to be directed." Now one of these subjects, perhaps the most important, is the comparative cost, light for light, of gas and electricity, and if last week's letter of "Chesterfield, junior," is a sample of this guidance, then the "picked men" will assuredly wish they had never been selected for serving on an Electric Lighting Committee. "Philip Stanhope" falls foul of Mr. Yeaman's contention that electric energy at 5d., 6d., or 8d. per unit is equivalent to gas at 5s., 6s., and 8s. per 1,000 cubic feet. This fact has been on record in the ELECTRICAL REVIEW for a long time past, but neither this nor Mr. Yeaman's reiteration satisfies the gentleman "who is getting some little notoriety for knowledge of electrical subjects."

"If Mr. Yeaman's calculation be correct," says the youthful Philip, "the would-be user of electric light has a very serious question to consider before he abandons gas;" and then he goes on to ask, "Where, then, is Mr. Yeaman's fallacy?" To this we reply that no fallacy exists. Mr. Dibdin, the chemist to the London County Council, writing from the chemical and gas department, informs us that we may generally estimate that a good flat flame burner will give a duty of about 3 candles of light per cubic foot of gas consumed, so that a burner consuming 5 cubic feet per hour will give a light of 15 candle-power. It is, therefore, correct to assume, at least, so far as London is concerned, that "3,000 standard candles burning for one hour are represented respectively by 1,000 cubic feet of gas, or 12 Board of Trade units of electricity," and therefore would-be users of electric light, to whom money is an object, must decidedly put on their considering caps, for a while at all events.

The conclusion of Mr. Preece that his P. O. burners gave about 2 candle-power or less per cubic foot of gas, was, at best, only a surmise on his part, for we have failed to ascertain that any actual tests were made; but even if true, it simply shows that through long continued use, or some other cause, these burners were not doing their duty.

As there are probably gas engineers in abundance who have acquired as much notoriety in their respective spheres as has "Chesterfield, junior," in the domain which he has made his own, we would like to ask whether, when compiling his comparisons, he took into consideration the fact that incandescent lamps as well as gas burners deteriorate in duty the longer they are used, and that the efficiency of 250 candles per unit lamps when new will drop to half that amount after a considerable number of hours' usage.

We were under the impression that *all* electricians who honestly considered the question on the 250 candles per unit basis, were agreed that the comparative costs of the rival illuminants, light for light, were as Mr. Yeaman has represented them. To calculate results by comparing well-used gas burners with newly-installed incandescent lamps is neither fair to the gas interests nor honest to our own, and who can wonder at the bewilderment of town councillors when they come across such conflicting and widely divergent statements as those we have pointed out?

ELECTRO-TECHNICS.

THERE seems to be an increasing tendency for the president of a scientific institution, in his introductory address, to lay aside the immediate and characterising problems of the society, to discuss some carefully chosen generality which shall be sufficiently near to the objects of the association to be recognised by its members as not exactly foreign to their cause, and yet not so far beyond the comprehension of the ordinary public as to be unpopular with the people outside. This deviation serves two ends: it brings the society and its president into notoriety before the world, and gives the general public the particular view of things as seen by a scientific observer. If the subject is wisely chosen the advantages of the innovation cannot be denied, but it must not be overdone.

Prof. Ayrton was particularly happy in his choice of a theme for his presidential address to the Society of Electrical Engineers, "Electro-technics" being just *electrical* enough for a title to be recognised by the institution at Great George Street as not entirely remote from their objects, and not too *technical* for the "thinking" public, which is generally assumed to begin just *beyond* Westminster. It is on all sides admitted that Prof. Ayrton has never spoken better than on this occasion.

From a historical standpoint this address is of special interest, as it is a record of the means by which the City Guilds Institute, as at present constituted, was called into existence. It is a tribute, also, to the history of the growth of technical education throughout our country. It also gives valuable data which Prof. Ayrton has derived from a carefully watched experiment in progress for the past 19 years—an experiment upon the "human machine"—to call forth an answer to the question, "How is it best to train the young engineer?"

His connection with the first promoters of a scheme for technical education in England has placed Prof. Ayrton among the pioneers in one of the worthiest social movements of the present century. This touch of personal zeal is not lost sight of throughout his address, but rather characterises it.

The evolution, in a few years, of a technical college, from two or three class-rooms and a cellar, in Cowper Street—which some of our readers will probably remember well enough—to the stately edifice in Exhibition Road, shows with what energy these pioneers have been at work. The success of the Central Institution and Finsbury College, as demonstrated by the number of students and the important positions they are taking in the world, is the crowning point of this "experiment." The City companies may well feel proud of their sturdy children.

There is much truth in the remarks made by Prof. Ayrton with regard to the management and government of engineering schools. He attributes the rapidity of the advance at the City Guilds Colleges as greatly due to the freedom which has been granted to the professorial staff by the projectors and governors of the scheme. In this way it has been possible to shape the course of studies so as to keep in touch with the requirements of the continually-changing profession; to advance, in fact, as the world advances, without having to rest on their oars awaiting the vote and approval of the governing body.

Looking beyond his own experience with engineering students, Prof. Ayrton brings before us the far wider question of what we may call "the nationalisation" of the working classes. Upon this latest advance in technical education, the *Standard* is rather dubious—expressing the somewhat ancient opinion that when young Hodge has mastered the text-book which the Royal Agricultural Society has prepared for his use, he will "look for some more ambitious and more lucrative employment than following the plough." There is no doubt that in time the young gentleman might object to the monotony of following that time-honoured implement; but we need have no fear that his dislike for this "sad mechanic exercise" will leave the farms unfurrowed. Rather, we should expect him to beat his ploughshare into the *field* magnet of an electro-motor, and evolve a more efficient plough, which will not need such heavy "following."

There are sweet little cynicisms here and there in this address, chiefly with regard to what, it seems, are, after all, but *pseudo* polytechnics; and we were beginning to feel so proud of them!

With that personal zeal for his own engineering craft, to which we have already referred, it is natural, perhaps, that "those other professions in which men engage" should be somewhat secondary in the heart and mind of the lecturer. In some cases these polytechnics may be used by over-worked mechanics for "recreative" purposes only. We venture to think, however, that an examination of the roll of members attending these feeble polytechnic courses would reveal quite a different class of student to those Prof. Ayrton suggests have filled their class-rooms.

For "useful *engineering* learning, usefully taught," let the student go to the institutions of the City Guilds by all means—he cannot do better. For those men, however, who do not want to be specialists—and, after all, these constitute the major portion of our population—some wider provision must be made. We do not need that all teachers in all colleges should "breathe the spirit of the factory" upon their students. Is factory atmosphere, even at Charlton, always so inspiring?

Technical education has respect, not alone to those who use their powers "to swink and sweat incessantly," but it is big enough to embrace the practical side of every man's calling. It is just here that the polytechnics come in. At present *their* professors, too, are only "experimenting." When their results shall be tabulated, and their virtues disclosed before some learned society, they may compare favourably with the record which Prof. Ayrton has so eloquently put before the Electrical Institution and the world.

COAST COMMUNICATION.

IN close connection with the question of the establishment of telegraphic or telephonic communication with lightships and lighthouses is that of coast communication.

We have received a pamphlet, written by Mr. Fredk. H. Maberly, urging strongly in the matter and giving some useful information.* Mr. Maberly estimates the cost of putting all our coastguard stations into communication with one another at £100,000. To this he adds a charge of £2,400 per annum for maintenance.

Considering that during the last 24 years some 4,038 vessels and 18,951 lives have been lost on our shores, or an average of 168 vessels and 789 lives a year, this expenditure would seem well justified from humanitarian views alone. The question, however, is recognised by the highest authorities as one of great national importance. One of the points brought most prominently out by the naval manœuvres of late years has been the value and necessity of coast communication.

Thanks to the outcry which has been recently raised, there is now little doubt that Parliament will be obliged to remedy this flagrant scandal, and sanction the expenditure of the necessary money.

As a technical paper, we naturally confine ourselves to offering suggestions which we hope may be of use in overcoming the technical difficulties in the way. In the case of coast communication proper these are non-existent. They undoubtedly do exist in the case of lightships and isolated lighthouses, but, as we have said before, we believe they can be readily overcome. Adverse critics are full of the pretended failures of the Sunk Lightship and the Fastnet Rock cables. Although the former was ultimately abandoned, it was by no means a failure, the experience alone gained being such as would do much to secure success on another occasion.

As to the Fastnet Rock cable, which broke down, we are afraid in that case the expenditure of money was scarcely sufficient, and those who designed and laid the cable seem hardly to have realised the difficulties of the work. As a set-off against this failure we have the Tory Island cable laid in the summer of 1889, which has now lasted nearly through three exceptionally bad winters. The difficulties which have thus been successfully overcome are by no means incomparable with those connected with the Fastnet Rock, and the success was no doubt due to a liberal expenditure in the cost of the cable and particular care in its laying.

The Government could do no better than to make the undertaking a national one, and place the execution and maintenance of the work in the hands of the General Post Office. Landline work is very quickly done, and for the submarine portion the two Post Office telegraph ships would amply suffice. The expense of maintenance would thus be reduced to a minimum, since the extra cost involved in keeping these ships at work, instead of laying up, would be trifling.

Another point which occurs to us is that of night communication with ships. Why are not the Tory Island and other cables open day and night? Is it because arrangements cannot be made with the Post Office, or because ships do not report themselves after dark? If the former is the case the Post Office should be dealt with by a high hand, but we are afraid that the vast majority of ships have no means of communicating with shore, or, indeed, with other ships, during the night, simply because a little knowledge of the Morse code is not required by the Board of Trade in granting an officer's certificate.

As we have called attention to Mr. Maberley's *brochure*, it is perhaps fitting to mention the unremitting labour of Mr. Robert Bayly, of Plymouth, who has for the past few years striven earnestly to induce the authorities to adopt coast communication, but it is evident that pressure from the House of Commons is necessary before any action will be taken. However this may be, sailors, and all concerned, owe a debt of gratitude to the public-spirited men who have advocated "in season and out of season" the necessity of telegraphic or telephonic connection on the shores of Great Britain.

* Marshall Brothers, 10, Paternoster Row, E.C.; J. Townsend, Little Queen Street, Exeter.

OVERHEAD WIRES.

THE letter which appears in our correspondence columns from Mr. Murray is one we have much pleasure in printing, as it explains to the readers of the REVIEW the reasons which led to the drawing up of the memorial to the Board of Trade *re* the use of overhead wires, and gives from an official source more information on this subject than has hitherto been published.

Mr. Murray finds fault with certain comments which we made in an article in our issue of the 15th ult., and as these were made from our point of view in the best interests of the electrical trade, we desire to say a word or two in justification of our remarks. In the first place we would point out that we do not in this matter pose as advocates of the Board of Trade; we still think, as we always have thought, that a relaxation of the stringent rules laid down by that Department is necessary, and we have consistently advocated such modifications of the rules as would render the use of overhead wires economically possible. In the particular case of this memorial, a reference to our issue of December 11th last will show that we were in entire agreement with the promoters of the memorial as to the desirability of further action with a view to removing the restrictions now imposed on the use of overhead lines; and that, subject to the one proviso that there was a sufficient ground for it in the letters received by certain contractors, we cordially approved of the movement.

Now as to this point of difference as to whether there was a sufficient ground for the action taken by the Chamber of Commerce, we look to Mr. Murray's letter and to the enclosure, No. 1, for a justification of our criticism, for we find in the former the following words in reference to enclosure No. 1: "It is true that this letter was sent in reply to Mr. Crompton's which contained a description of the system proposed to be adopted for the electric lighting of Chelmsford;" and further we see that the letter he refers to (which by-the-bye is not dated) is headed, "Chelmsford Electric Lighting License, 1890," and commences, "With reference to your letter of the 28th ult., containing a description of the system of supply proposed to be used for the purposes of the above-mentioned license, I am directed . . . ."

Now this appears to us to exactly bear out our point, viz., that the letters referred to in the communication sent out with the memorial were addressed to individual contractors in reference to lines already erected or planned by them; and with all due deference to Mr. Murray, we cannot agree with him that the only construction of which this letter is capable is that the Board of Trade has sternly set its face against the principle of overhead wires, as it appears to us by the heading and opening sentence that the letter can only mean that the Board of Trade will not approve of overhead wires in the town of Chelmsford. The fact that no reason is given in the letter for this decision need not surprise anyone conversant with the ways of Government departments, and it seems to us that, at this stage of the proceedings, a further communication asking whether the prohibition of overhead lines was to be taken as applying generally to all districts or not, and if not, what were the reasons which led to their prohibition in Chelmsford, would have better met the case than the memorial already referred to.

In conclusion, we may perhaps be allowed to refer to what is, we suppose, a slip on Mr. Murray's part in the commencement of his letter, as the words which he quotes from our article, and regrets that we should have used, seem to us quite natural and in the best interests of the trade; indeed, we feel sure that he must really agree with them himself, as there is no doubt that the position of the electrical trade section will suffer, *if there is ground to suppose that it acts hastily and without due consideration.*

BLUNDERS IN TELEGRAMS.

THE correspondence on this subject which has been so vigorously carried on in the pages of the *Standard*, seems now to have practically terminated, and although the same has been decidedly one-sided, *i.e.*, the apologists for the Department have been but few in number, yet it can hardly be fairly held that the majority have left nothing to be said for the other side. There certainly seems to be an impression abroad that inaccuracies are practically a modern innovation brought on, of late years especially, by the Postal management. Now, anyone who can recollect the literature and lectures of some twenty-five years back, dealing with telegraphy when the latter was in the hands of the companies and not of the State, must be able to call to mind the fact that the stock matter was the relation of telegraphic blunders and the awkward consequences resulting therefrom. At that period what was the yearly total of messages transmitted throughout the United Kingdom, and how does it compare with the some 70,000,000 which are dispatched now? Can anyone honestly say that the present percentage of blunders is larger now than it used to be? "One swallow does not make a summer," but some people would appear to argue that it certainly does, judging from the statements of each individual who practically says that because *my* telegram was incorrectly sent, therefore the whole system is rotten. It has been suggested that cheap work is the cause of all the trouble; that the Postmaster-General, in order to make a big surplus, does his work cheaply, and therefore nastily. Now, as a matter of fact, the surplus that is yearly shown in the Post Office accounts is due to postal and not telegraphic business, and to appropriate this to make the cheap work necessarily (?) more efficient, means to tax the whole community for the benefit of the few. For presumably the surplus millions go indirectly to the relief of the tax-payer, and if they are not forthcoming the deficit must be made up by a general tax all round. As regards cheapness, it seems to be forgotten that the sender of a telegram is very often to blame, as in order to save a few pence he will cut the message down to the narrowest terms of intelligibility (often unintelligibility), leaving no margin whatever for possibility of error, which error, if made in a more diffuse communication, would in all likelihood not have caused any awkward consequences. The repetition of a message is a safeguard which is not often resorted to, but even the delay which this involves might be saved if the extra fee which would have to be paid were used in making the original more extended.

At the same time there is undoubtedly very great carelessness often exercised on the part of the telegraphist, and it seems a mistake that some kind of check, such as was in force in the days of the companies, when the transmitted and received telegrams were all compared, and any errors found were visited by a fine from the offender amounting to not less than one-eighth of a day's pay, cannot be adopted. This, of course, would not absolutely prevent mistakes, but it would, at least, make the operators more careful than they are at present. The expense of such checking would be very heavy, but if the public like to pay for the safeguard they could, no doubt, have it.

THE AMERICAN ELMORE COMPANY.

DURING the progress of the speculation initiated by the South Sea Company, an ingenious card maker published a pack of playing cards, each card containing, besides the usual figures, a caricature of a company of the period with appropriate verses beneath. One of the most famous of these was "Puckle's Machine Company," for discharging round and square cannon-balls and bullets, and making a "total revolution in the art of war." Its pretensions to public favour were thus summed up on the eight of spades :—

> A rare invention to destroy the crowd
> Of fools at home instead of fools abroad.
> Fear not, my friends, this terrible machine,
> They're only wounded who have shares therein.

The nine of hearts was a caricature of the "English Copper and Brass Company," with the following epigram :—

> The headlong fool that wants to be a swopper
> Of gold and silver coin for English copper,
> May, in Change Alley, prove himself an ass,
> And give rich metal for adultrate brass.

We hope that the quotation of these doggerel lines of the past may be considered to be sufficiently excused by a certain appropriateness to more recent events.

To all who are familiar with the Elmore copper depositing process and the Elmore Company promoting process, it will be matter for surprise and regret that one more company (Elmore's American and Canadian Copper Depositing Company, Limited), should be added to the list which we

published in our issue of October 10th, 1890. We now reprint that list with the later addition.

Elmore Company.	Capital issued.	Purchase price.	
		Cash.	Shares.
English	£140,000	£53,400	£46,600
Wire (including premium)	300,020	125,000	20
Foreign and colonial	120,000	80,000	30,000
French (including premium)	233,375	116,875	66,500
Austro-Hungarian (including premium)	237,500	87,500	50,000
American	200,000	110,000	70,000
	£1,230,895	572,775	263,120
		£835,895	

The first issue was made in 1889, and as we pointed out in our article on the English Elmore Company's last report, the manufacturing profits, if any, which have been made can only be ascertained by the details of a small item in the profit and loss account, which details were not furnished to the shareholders. The three years which have elapsed since the first company was formed should have given some opportunity of indicating commercial success, if there were any prospects of it; but no such indications are forthcoming. Instead, the shareholders have been provided with vague promises and unbusinesslike statements, and new shareholders are being enticed with the same pabulum. We have so often had occasion to show the absurdities and extravagancies of Elmore prospectuses, that we have no intention of going over the same ground again. It will suffice to record that in 1892 they depend upon the same misleading generalities as in 1889. Upon these misleading generalities the public are asked to subscribe £200,000, and the vendors have already arranged to take £180,000, or 90 per cent of that sum, out of the company. With the remainder the directors expect to erect in New York a small plant to demonstrate the merits of the process, and then in one or other of two ways to be in a position not only to recoup the capital with a large bonus, but, in addition, to pay considerable annual dividends.

The company does not intend to work the process; on the contrary, the bait held out to investors is the sale of rights to sub-companies, which, in Elmore affairs, is much more profitable than working the process. America, apparently, offers exceptional opportunities for the sub-company business. In Europe the unit for Elmore companies has been one country at least, but the promoters have discovered that in America there are forty-two States, and we are expected to believe that no State will consider itself complete without its little Elmore.

There is an arrangement for the allotment of shares "as nearly as possible" to applicants who are shareholders in other Elmore companies, and to general applicants who are not shareholders, in certain specified proportions, and it is provided that *purchasers of shares in the existing companies, whose names shall not have been registered by the date of allotment, will be deemed to be shareholders, and will be entitled to an allotment on presentation of transfers, duly executed.* We hope that such a plan had nothing to do with the creation of a fictitious demand for existing companies' shares.

The utility of Elmore tubes as steam pipes is not specifically mentioned in the prospectus. It will be remembered that some time ago we quoted from a contemporary a letter by the late Mr. Alexander Watt, in which he stated that on the application of heat the tubes would exfoliate, and would consequently be unsuitable for steam pipes. The only instance of Elmore tubes in actual use for the purpose that we remember to have seen was that furnished by a shareholder of the company, who stated that he had tried some and they had completely failed *by becoming laminated.* We do not forget that an explanation was offered, or that the same explanation has been found very useful before.

In the list of quotations we find no mention of the Austro-Hungarian (or German) Company. Is it because its shares are not quoted at a premium? Is it because our forecasts of its prospects are being verified? In the list of dividends, that of the English company is mentioned as having been paid from the sale of a license to manufacture wire. It is not mentioned that the Foreign and Colonial Company's dividends have been paid solely from the proceeds of sales of patents to sub-companies promoted by the same promoters, and largely controlled by the same persons as the parent company.

Skilfully as the prospectus is drawn to attract the unwary, we doubt very much if the public will have subscribed for the shares to any extent. If they have, it is always possible that they may subscribe also to the forty-two State companies *in posse.* In that way a profit may be made. We are not familiar with the methods of company promotion in America, but we think that it would be very unwise to place any reliance on the inhabitants of the United States providing capital to purchase for fabulous sums such rights as this company will have to sell.

If the merits of the Elmore process were all that its promoters claim for it, we can hardly understand the public subscribing to the present issue. Let us put briefly what the prospectus offers. The capital is £200,000, in £2 shares. 65,000 shares are priority shares; 35,000 are deferred shares. The vendors take the deferred shares in part payment; the public are to subscribe £130,000 for the priority shares. When they have done so, the vendors are to take £110,000 out, and the other £20,000 is to be utilised by the directors and the patentees for the purpose of making a demonstration on the chance that a profit may be made by the re-sale of rights for separate states, or that a "powerful group of American capitalists" may be so favourably impressed, as to pay a large sum in cash and shares in sub-companies to be formed by them.

It should be known that there is no mystery whatever about the Elmore process, and nothing in it which can alter the laws of electricity or the laws of trade. The only mystery is that companies should have been formed with an aggregate capital of £1,230,895 to work it, and that the estimates of its interested advocates should continue to be accepted, and investment of new capital permitted, until some tangible results are obtained from the old. As a specimen of reliance on a confiding public, it seems to us that the last prospectus is even more remarkable than its predecessors. It should be clearly understood that all the appearances of prosperity are due to company-mongering, and nothing else. The shareholders of each company may hope that more purchasing companies may follow, but the public should know that such proceedings must end, and that while they last it is only the public living

on the public, with considerable leakage to promoters and others for every company formed. We believe that the shareholders will be better advised to take stringent measures for turning their works to commercial uses and ensuring the proper employment of the capital that remains than in endeavouring to shift their burdens on to other shoulders.

We do not doubt that the promoters were gratified on learning that a gentleman so honourably and widely known as Sir Francis De Winton, C.B., K.C.M.G., had agreed to accept the position of Chairman of the Company. In the present method of obtaining capital such names are of considerable value, the public investing on the strength of them and without enquiring into the merits of the investment offered. This may be the more excusable when the prospects held out are supported by a list of quotations of other similar companies of which all that are mentioned are over par; and a list of dividends which comprise announcements of 50 per cent. and 100 per cent., yet we venture to express the opinion that Sir Francis de Winton is hardly to be congratulated on the acceptance of the position.

Nearly one and a quarter millions sterling is a large sum. With that amount invested in legitimate undertakings, how much might not have been done for the public good and the benefit of the electrical profession. Of course a part of this is counted twice over, and it cannot at present be known how many of the shareholders have had their money back again. When the Elmore incident has been closed there will be the usual reckoning. The public will have to take its share of blame. The use of capital in most commercial undertakings implies a moderate, if not modest, return. Instead of accepting it, the public seek to obtain extravagant rewards, and thus make it more easy for those who are ready to offer extraordinary returns without any scruples as to the result.

The Influence of Thunderstorms upon Instruments for Measuring Terrestrial Magnetism.

Mons. Moureaux in a recent issue of *Ciel et Terre*, has pointed out the coincidence of several lightning flashes noted in the neighbourhood of the Observatoire du Parc Saint-Maur, with certain small movements in the registering magnetometers there, movements analogous to those which are communicated in making the hourly adjustments. This coincidence, as was pointed out at a recent meeting of the Paris Academy of Science by Mons. Em. Marchand, has frequently been seen at the observatory at Lyons. In a paper, which may be consulted in the *Comptes Rendus*, vol. cxiv., p. 29, Mons. Marchand has given some interesting statistical information concerning the coincidences observed since 1887. From the meteorological journal of the observatory he has collected all the cases in which flashes of lightning were timed, and he also examined the magnetometer curves, with the following results: — 1. There are 14 cases in which the disturbance in the curves is easily visible, and which determine the accuracy of the observed time of the lightning flash. 2. Fifteen cases occur in which the trace of the oscillating movement, although slight, is still visible, especially if one knows where to look for them by knowing beforehand the observed time of the lightning flashes. 3. There are fifteen cases in which the oscillations were less defined. 4. Finally, only five cases appear in which the lightning flash was unaccompanied by a perturbation in the magnetometer leaving a definite trace of its movements in the curve. The oscillations are not generally of the same amplitude in the three kinds of instruments commonly used in observatories, and the declinometer and the bifiliary instrument, the sensibility of which two is about the same, often present differences of amplitude which are very notable. It appears, from an examination of the statistics, that there exists some simple relation between the distance at which the discharge takes place and the amplitude of the oscillations in the magnetometer which it gives rise to. This relation, we presume, Mons. Marchand will now endeavour to determine, so that, if necessary, due allowance may be made in evaluating the readings of the instruments during the electric perturbations of the atmosphere.

The Light Emitted by Incandescent Zinc Oxides.

Zinc oxide appears from some experiments recently made by Messrs. Nichols and Snow, to be a material, which, in addition to the ordinary incandescence due to temperature, is highly luminous above 880° C. The phenomenon is of the class which Becquerel and others of the earlier students of the subject have described as "phosphorescence by heat." Owing to the presence of the ordinary incandescence at such temperatures this property of zinc oxide seems hitherto to have escaped investigation. There are good reasons for supposing that other of the metallic oxides will show peculiarities of radiation when heated, similar to those exhibited by the oxide of zinc. Cylinders of lime, for example, when freshly ignited in the oxy-hydrogen flame, attain a momentary brilliancy and whiteness which is not reached during any subsequent ignitions. But it may not be momentary in others, and we recommend the subject to those who are frantically endeavouring to improve the prospects of gas by the introduction of various "baskets," "gauzes," "cones," &c., of refracting metallic oxides into the gas-flame with a view to imparting a "borrowed splendour" to the light emitted. There may or may not be something in it, but at any rate when the gas companies are being daily reduced to a more parlous state, and shareholders are expressing their apprehension in terms that cannot be misunderstood, the saying, "any port in a storm," might be worth acting upon. We note that in the research carried out by Messrs. Nichols and Snow, and which our readers will find fully reported in the January number of the *Philosophical Magazine*, that the comparison lamp employed was an incandescent lamp maintained at a constant voltage, the temperature being below normal to secure permanence; and the zinc oxide was heated in platinum foil by the application of an electric current.

Automatic and Multiplex Telegraphy.

We have received a copy of a paper on this subject by F. N. Gisborne, published in the "Transactions of the Royal Society," Canada. The chief object of the paper is apparently to advocate the use of the F. Anderson Automatic Machine Telegraph, an apparatus which appears to possess practically no points of novelty whatever, all the points which are brought forward as being novel, being ancient history. The *new* system is *reported* to have worked between New York and Washington on a copper wire, 351 miles long and 2 ohms per mile resistance (not a remarkably difficult line to work through), at a speed of 3,000 words! per minute. By the Keeley system 13 distinct circuits are said to be available on one wire. Referring to these systems, Mr. Gisborne builds up a magnificent prospect of what could be done in Canada in the telegraphic way, and he says that 40 years' experience in practical telegraphy confirms the correctness of his estimates. We fancy that the 40 years' experience has still left the author much to learn.

FIRE STATISTICS AND FIRE TELEGRAPHS.

THE annual report on fires in London, which for more than thirty years appeared with that punctuality and celerity characteristic to the London Fire Brigade and its former chief officer, Captain Sir Eyre M. Shaw, K.C.B., bears now for the first time the name of Mr. J. Sexton Simonds, the indefatigable and gallant officer who was promoted, on the retirement of his chief, to the post of Commander of the Metropolitan Fire Brigade.

According to information contained in the *Standard* of January 23rd, it appears from the present report, as was to be anticipated, that in consequence of about 7,000 houses having been added every year to the Metropolis, last year's fires were more numerous than those of any year since the duty of extinguishing fires in London devolved on the Metropolitan Board.

The official returns compiled by Captain Simonds are again a self-evident proof of the overwhelming work which the Fire Brigade performed during last year. If we consider that 4,164 calls, or over eleven calls a day, had to be attended by firemen with suitable appliances, and that the number of firemen available for general work at fires and employed on the several watches kept up throughout the Metropolis amounts to only 706 men, including officers and superintendents, we are driven to the conclusion that the amount of work accomplished was again very heavy during last year.

The figures in the following table, extracted from the yearly reports of the chief officer of the Metropolitan Fire Brigade, bear exclusively upon those questions with which we are here principally concerned, viz :—On fire telegraphy and on the influence which this has upon the protection of life and property.

Year.	Number of fires (false alarms and chimney fires *not* included.)	Number of points at which fire alarms can be raised.		Proportion between public alarm points and inhabitants.	Percentage of serious fires (all according to the chief officer's own classification.)	Lives lost per 100 fires, not including lives of men belonging to the Brigade.
		Electrical street call points.	Total number of alarm points, including engine and fire escape stations, street call-points, telephone, telegraph, and bell-alarm stations.			
1878	1,659	...	163	1 : 18,857	10	1·51
1879	1,718	...	170	1 : 18,871	9	1·86
1880	1,871	40	218	1 : 15,333	9	1·76
1881	1,991	44	233	1 : 14,923	8	2·01
1882	1,926	77	271	1 : 13,322	9	1·87
1883	2,144	151	407	1 : 9,203	9	1·82
1884	2,289	220	470	1 : 8,256	9	1·83
1885	2,270	263	510	1 : 7,871	7	2·07
1886	2,149	347	603	1 : 6,880	7	2·28
1887	2,363	349	642	1 : 6,565	7	2·33
1888	1,988	358	656	1 : 6,529	6	2·41
1889	2,338	365	684	1 : 6,320	7	1·88
1890	2,555	385	768	1 : 5,680	6	2·39
1891	2,892	502	889	1 : 4,952	7	2·11

Leaving aside all calls for chimney fires and false alarms, there were 2,892 actual fires, of which 193 resulted in serious damage ; or in other words, there were about seven per cent. of serious fires. Taking the average of the decennial period from 1881 to 1890, both inclusive, the serious fires appear as 162 per annum. We have naturally an increase in the yearly number of serious fires, but the percentage shows a decline from 7·5 to 6·7 ; an achievement which merits the high approval of every inhabitant of this vast Metropolis.

It is highly satisfactory to see that the progress which the London Fire Brigade is yearly manifesting, not only consists in the advance of its numerical strength and efficacy, but must also be estimated by the steady adoption of all possible scientific appliances, especially by those electrical means of communications which so considerably reduce the distance to be run by persons giving alarms of fire, and consequently the time of conveying information to the Brigade's stations. A glance at the results shown in the above table, affords the decided proof that street call-points, telegraph and telephone circuits do reduce the proportion of serious fires, and thus considerably diminish the destruction of property by fire.

The total number of alarm-points which London possessed during the past year was 889, arranged in the following manner :—

55 land fire-engine stations.
4 floating or river stations.
51 hose-cart stations.
179 fire-escape stations.
502 electrical street call-points round fire stations, and included in 55 alarm circuits.
21 telephones to police-stations.
8 telegraphs, 55 telephones, 14 bell alarms } To public and other buildings.

889 public fire-alarm points.

And if we take the population of London as 4,403,000, this gives the improved proportion between public alarm-points and inhabitants as 1 to 4,952.

With reference to the deaths caused by the London fires of last year, we find in Captain Simonds's report, that life has been imperilled in 47 fires, 61 lives were sacrificed, though in half the fatal cases the sufferers were taken out alive, death ensuing in hospitals or elsewhere ; or in other words, the lives lost at every 100 fires amounted to 2·11.

The percentage of lives lost through fires has, when comparing the results of a number of years, not been appreciably influenced by an increase of alarm-points. In spite of the increased efficiency of the Brigade, and in spite of more extended electrical circuits, modern fires show a more destructive tendency. This is principally caused through social changes in the way of living, the increased use of combustible appliances, and in the light construction of dwellings ; all apparently tending to increase the percentage of lives lost. It seems that the corps of the London Fire Brigade, having accomplished its honourable and hazardous duties with its renowned bravery and deeply rooted sense of duty, has arrived at that maximum of efficacy, which human power, based upon all available scientific resources, bravery and discipline of men, is able to offer, and can oppose no further resistance to the common fiend of conflagration ! Although our table seems to indicate that the percentage of serious fires has been reduced most effectively during the last thirteen years, and has now arrived at a minimum standard, and that the percentage of lives lost has likewise attained a minimum level in accordance with the particular circumstances of causes and influences, we should, however, never abandon the hope that the Fire Brigade will finally reach an efficiency, when it will be in a position to decrease the death-roll from fires to an unavoidable minimum, and the percentage of serious fires to a still lower standard than the present one. In the realisation of these hopes we are sure the further increase and perfection of electrical communications would undoubtedly be an element of importance.

ELECTRIC WORK IN THE PRINTING OFFICE OF THE VIENNA "FREMDENBLATT."

[FROM OUR OWN CORRESPONDENT.]

BOTH the morning and the evening editions of this paper are now printed by means of electric power. Hitherto the printing machines and their auxiliary appliances have been actuated by two engines, each of 8 horse-power, which drove two rotatory machines, two rapid presses, the stereotypic cutting machine, and a dynamo for the electric light. The two engines are now superseded and the rotatory machines and presses impelled by an electro-motor of 10 H.P. on the system of Ganz & Co. The current is obtained from the mains of the International Electric Company. It is conveyed by a cable at a tension of 2,000 volts, and transmitted by two wires to the transformer, which is placed in a small side room next to the presses. The transformer is enclosed in a wooden casing. The warning "do not touch," in large letters, shows the critical point of the entire installation, whilst there is no danger in the electro-motor and in the remaining machinery. The high tension current is divided in the transformer, brought down to 100 volts, and is then conveyed to the alternating current motor. This motor enables 10,000 sheets of the "*Fremdenblatt*" to be printed in an hour on each of the rotatory machines. The entire

service has been essentially simplified. The electric light is in action in all parts of the establishment to the extent of 200 glow lamps at 16 normal candles. The compositors rejoice at the change: They are freed from the heat and the fumes of the gas flames produced so near their heads. The vaporous atmosphere of the compositors' rooms has disappeared.

THE MARSON BATTERY.

EACH cell of this battery, which is constructed on the principle of those known as "Regenerative Cells," consists of an outer vessel subdivided into three compartments by two partitions, one made of the same material as the cell itself, and the other of an ordinary porous plate. There is a gas tube going from the bottom of the centre compartment to the top of the side compartment formed by the non-porous division, the latter compartment being sealed gas tight at the top. The elements used are—in the centre compartment a special compressed plate (similar to lithanode) made of carbon, lead dioxide, potassium salts, and an organic alkaloid: to this element is soldered a brass terminal; the other element used in the compartment formed by the porous division, is a plate of zinc-calcium alloy (which is stated to have the great and remarkable property of being unaffected by the strongest excitant, if left in the battery, when the same battery is not in use or on open circuit). The alloy is prepared by a special process (thermo-electric) on a mixture of zinc, chloride of calcium, sodium, by which process there is obtained, chloride of sodium and a strong alloy of zinc and calcium, which is used for the preparation of the battery plates. The percentage of calcium in the battery plates averages 5—8¼ per cent. The solutions used are—in the zinc compartment, dilute sulphuric acid, and in the centre, a special depolariser, made of a mixture of potassium, sodium, and bismuth salts. The salt of bismuth is said to render the depolariser (in some manner) more capable of taking up the oxygen which is used in the regenerative process. Also, it is found by the above combination of elements, that if the two compartments referred to be filled with dilute sulphuric acid, the cell may be used as a secondary cell or accumulator; this is similar to the lithanode cell.

To use the cell as a primary, both compartments are filled with their respective solutions; when the battery is ready for use it is said to give (No. 3 small cell) 2·1 volts 2·25 ampères, and will sustain this constant, without any attention, for 17 hours. At the end of this time the zinc compartment will require refilling, and the centre compartment regenerating; to do this a stopper on the third compartment is unscrewed, and it is half filled with hot water, and to it added a spoonful of oxygen mixture (sold at 5s. per lb.), and the stopper replaced, a stream of oxygen will be immediately given off, pass through the tube through the depolariser, re-oxydising it again fit for use for another 17 hours' spin; at the end of this time it will require similar treatment. The depolariser *never requires renewing*, only re-oxydising.

The following is given as the cost of working:

6 SMALL NO. 3 CELLS IN SERIES.

Time.	E.M.F.	C.	Remarks.
	Volts.	Ampères.	
8 a.m. ...	12·2	2·5	Short circuited on lamps.
10 p.m. ...	12·0	2·13	Readings taken, open circuit
8 a.m. ...	12·1	2·2	" " short circuit
2 p.m. ...	12·0	2·1	" " re-oxydised, &c., short circuit
2.30 a.m....	12·2	2·54	" " short circuit
10 p.m. ...	12·1	2·21	" " open circuit
8 a.m. ...	12·2	2·3	" " short circuit
6 p.m. ...	12·0	2·1	" " re-oxydised, &c.
8 a.m. ...	12·2	2·3	" " short circuit
10 p.m. ...	12·0	2·1	" " open circuit
8 a.m. ...	12·1	2·15	" " short circuit
2 p.m. ...	12·1	2·1	Test closed

All the time when on short circuit the cells were running two 12-volt E. and S. lamps (arranged in parallel) and kept them fully lit. The batteries required attention once every 20 hours.

Thus a total 58 hours run with a constant 12 volts and 2 ampères, gives

$$12 \times 2 \times 58 = 1,392 \text{ watt hours,}$$

and during this time there was used

	s.	d.
3¼ lbs. zinc alloy at 5d. ... ... =	1	4¼
Regenerating ... ... =	0	1
Excitant ... ... =	0	1¾
Labour ... ... =	0	1
	1	8

or at the rate of 8½d. per Board of Trade unit.

[The foregoing are the figures as they were given us, but

$$20\text{d.} \times \frac{1,000}{1,392} = 1\text{s. } 2\tfrac{1}{4}\text{d. and not } 8\tfrac{1}{2}\text{d.}$$

Again, taking the average current for the 58 hours' run at 2·1 ampères, the theoretical consumption of zinc should be

$$\frac{58 \times 2{\cdot}1 \times 18{\cdot}72 \times 6}{7,000} = 1{\cdot}95 \text{ lbs.}$$

whereas the actual is stated to be 3·25 lbs., or 66⅔ per cent. more than the theoretical amount. How this can be reconciled with the statement that "the zinc-calcium alloy is unaffected by the strongest excitant if left in the battery when the battery is not in use or on open circuit," it is difficult to see.—EDS. ELEC. REV.]

THE STERILISATION AND "AGEING" OF FERMENTED LIQUORS BY MEANS OF ELECTRICITY.

THE wine and spirit trade has probably experienced more of the humbug of those whom Mr. Knudson of the New York Electrical Society calls "fakirs" than perhaps any other section of the commonwealth, always excepting, of course, the "great belt-buying public." Processes for the mellowing or ageing of wines and spirits by means of electricity have been proposed almost ever since electricity began to have any commercial being, and yet we are not aware that any remarkable success either practically or financially (which is unfortunately not always the same thing) has been achieved by either of them. Fusel oil still flourishes. Hence, we fear it will prove all the more difficult for Mons. de Meritens to convince "the trade" that he has a good thing for them in his system of sterilising and ageing fermented liquor by electricity.

Mons. de Meritens is a scientist of no small repute in France, and from his published writings we know him to be one who would perform careful research and base his theories or propositions upon experimental results before announcing them to the general public. He claims to have shown that electricity may be used not only for the complete sterilisation of wine and other fermented liquors, but that it will, under proper control, mature or age these beverages.

It is not a new thing to hear that the lives of microscopic beings may be destroyed by the proper application of the electric current. Our pages have again and again chronicled the researches of scientists in this direction. It is by destroying the lives of the microscopic organisms which carry on fermentation that this fermentation can be stopped. To kill all such beings in a liquid and then to prevent the ingress of others is the function of sterilisation.

As in the case of beer, the "diseases" of wine, as the old writers used to call them, are principally due to the action of foreign ferments, and the life history of these can, it appears, be brought to an abrupt termination by the application of electricity from an alternating current machine. The wine is thus sterilised, and will not be liable to any further change.

Some of the French journals have recently been devoting considerable space to the discussion of this subject, which, of course, is one of great interest in a "wine country" like France is. The *Journal des Brasseurs* appears to regard the new process with great favour, and such, apparently, is the attitude of our own *Brewers' Journal*, if we may judge from

the tone of an article which recently appeared in its pages. But, without further digression, we will place before our readers the information available.

The results of Mons. de Meritens researches were tested at the Laboratoire Municipale de Chimie at Paris. Here is a typical experiment :—Two samples of the same wine, one of which had been subjected to the alternating current, and one of which had not, were submitted for analysis. The untreated wine was found to contain yeast cells in a more or less active phase of existence, besides a large variety of bacteria, of which a great many were in motion. On the other hand, the "electrified" wine showed only dead yeast cells and bacteria devoid of motion.

The next test was undertaken with a view to deciding whether what we have termed the "electrified" wine was liable to undergo a new fermentation, and the results were favourable, although, we presume, not even Mons. de Meritens himself would assert that if the wine were left exposed to the air it would not ferment; in order to preserve it intact it must, of course, be well bottled or casked.

Other laboratory tests were performed, and the whole series of tests proved so satisfactory that the French Minister of Agriculture instructed Mons. de Meritens to proceed to Algeria, and to make practical experiments in different parts of the colony. Commissioners were appointed to seal kegs of wine submitted in their presence to the electrical treatment, as well as kegs of the same wine untreated, which latter were to be kept for comparison with the former. The wines were subsequently shipped to France, and they remained on the Quai de Bercy for two months.

A committee was now appointed by the Minister of Agriculture to examine the wines and draw up a report, of which the following is the substance :—

1. All the wines subjected to the electrical treatment have kept well, and show every sign of continuing to keep well.

2. The untreated wines are more or less "gone off" so as to be unfit for sale.

3. Those wines that are just "pricked," as the trade term it, before being sterilised by the electrical process have undergone no further change since the treatment. The "disease" seems to have been arrested, whereas the same pricked wines that were not sterilised have become in the meanwhile sour.

4. The electrical treatment has not communicated to the wine any peculiar flavour. Upon the contrary, it is observed that the electrified wines have improved as if by age. Analyses of the treated and untreated wines show the former to have undergone since the date of their sterilisation no alteration in their chemical composition, whereas the untreated wines have changed. The ferments are found to be dead in the electrically treated wine, while in the untreated wine they are still living.

From this report, which we are bound to regard as being quite fair and unbiased, it appears that Mons. de Meritens' process is adapted either for preserving healthy wines or for arresting change in wines that have been already slightly attacked.

But the question naturally suggests itself, will the effect be lasting? We are assured, however, says the *Brewers' Journal*, that some of the wines treated by this process have been left for two years, during which time they were not racked, and at the end of the time they were as bright as at first. The important point in this statement to us is that so long a trial has been given to the process before "booming" it; this is what may be called a good "healthy" sign.

Electrical plant has been fitted up at Bercy, which enables about six barrels of wine to be sterilised in an hour at a cost of about 16d. per barrel. Unfortunately we have no details at hand regarding this installation, neither are we able at present to give any account of the *modus operandi* of the process.

It was stated above that the wine is not only sterilised by the de Meritens process, but it is also aged, and the writer in the *Brewers' Journal* seriously puts forward the following explanation of this fact :—"The ageing of wine is probably due to a long series of chemical combinations, which begin to take place as soon as the wine leaves the press, and which go on slowly under the influence of *very* slight electrical energy due to the variations of temperature, to the shaking of the ground, as well as to the variations in the electrical state of the atmosphere." But comment upon *this* proposed "explanation" is scarcely necessary in these pages.

GAS EXPLOSION IN VIENNA.

[FROM OUR OWN CORRESPONDENT.]

On the 19th ult. there occurred in Vienna in the palace of the Ritter von Guttmann, in the Schwindgasse, a gas-explosion which reached considerable dimensions, the violence of which terrified not merely the inmates of the house itself, but those of the adjacent premises. It is due only to a fortunate accident that the explosion did not prove a real catastrophe. Concerning this event we take the following details from the Vienna daily paper :—

The explosion was accompanied with a detonation like thunder. The ground and the walls trembled; the furniture was destroyed; all the panes of the 60 windows looking into the court of the four-storey palace—more than 500 in number—were shivered, and many of the plate-glass windows looking towards the street could not resist the vehement pressure of the air. It must be pronounced fortunate that amidst this ruin no serious injuries to human beings resulted. One person only, the cook, Dorothea Roschofsky, was injured, and, as it appears not dangerously.

The explosion occurred in the ground floor of the habitation of Count Montmarin, the First Secretary of Legation of the French Embassy. The count had already left the house and the servants were engaged in arranging the rooms (it seems strange according to English ideas that a "palace," should be let off in suites of apartments), when the cook, Roschofsky, was entering the kitchen with a burning candle. She had scarcely crossed the threshold when the explosion ensued. The cook was hurled to the ground and all readily inflammable objects took fire. The carriage of Lady von Guttmann was in the court ready to drive out. The horses shied at the detonation and the shower of falling fragments of glass, and the grooms had difficulty in pacifying the animals so as to unyoke them and lead them back to the stables. After the inmates had recovered from their surprise they hastened to the kitchen, extinguished the fire, and assisted the wounded cook. Two engines of the municipal fire brigade arrived, accompanied by a division of the volunteer salvage corps, a commission of police, and representatives of the Gas Company. The latter could not up to noon decide on the cause of the explosion, but it is probable that a large quantity of gas had escaped from a gasalier. The cook, who was in the service of Count Montmarin, was injured in both hands, and in her face.

THE TRAVELLING SIDEWALK.*

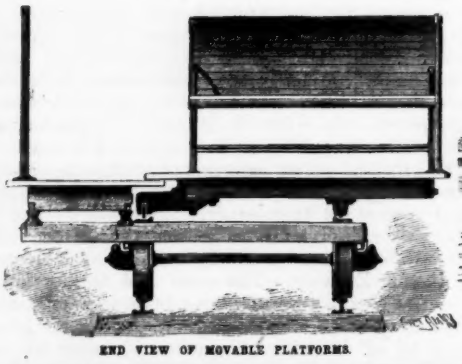
On a section of the World's Fair grounds at Chicago there is now being operated, on an endless elevated railway track, elliptical in shape and 900 feet long, a travelling sidewalk, a portion of which moves at the rate of six miles an hour, while another portion by its side moves three miles an hour. The whole structure is under cover, as shown in the principal view, and the system, which is a patented one, has been put in operation as a test of its practicability by a company of which Arnold P. Gilmore is president and O. Chanute vice-president. The slower moving platform, as shown in the end view, is carried at one side on a frame of 2½ inch by 6¾ inch pine sills, from the cross beams of which depend boxes in which are journalled the wheel axles, the wheels being 18 inches in diameter with 3 inch tread, and running on an ordinary T rail track of 3 foot gauge, while the faster moving platform, extending slightly over the edge of the first one, is carried by two flexible steel rails resting directly upon the peripheries of the wheels. The rail is held loosely in a shoe or socket in each cross beam, and the weight of the platform, whether loaded or empty, presses upon the rail sufficiently to give the necessary friction to move the load. The rails are of rolled steel, 4 inches high and half an inch thick, and are made in lengths of 30 feet, joined to make a continuous rail the entire length of the road.

The shoes are made of casehardened steel, and the rail slot has an opening of five-eighths of an inch, allowing an eighth of an inch play to the rail for lateral motion in rounding curves. The difference of speed of the two platforms arises

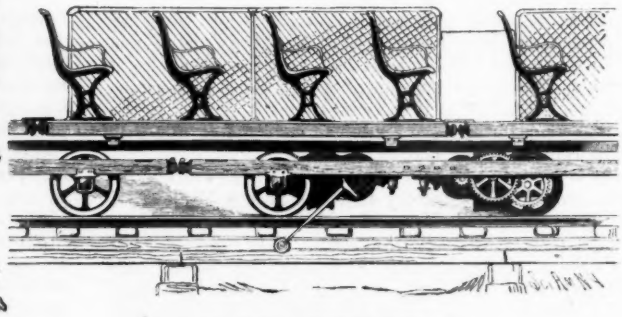
* *Scientific American.*

from the fact that the top of the moving wheels, on which the flexible rail travels, has a forward motion twice as fast as that of the axles, from which the slower moving platform is supported, and this ratio of one-half difference in speed of the two platforms would be maintained with wheels of any size. The platform moving at the rate of three miles an hour adjoins a stationary platform, from which one can step on to the movable platform without jar or inconvenience, as almost any one readily walks at this speed, while no greater the passenger stopping himself instead of the car. With the six mile continuous speed thus obtained it is claimed that this method offers great advantages for the moving of large crowds over short distances, where the traffic is constant, and this method has been proposed for transporting visitors about the Fair grounds during the Exposition period.

The motive power is electricity, furnished by a Thomson-Houston generator of 107 horse power. There are three trucks provided with two 15 horse power Thomson-Houston



END VIEW OF MOVABLE PLATFORMS.



SIDE VIEW OF ELECTRIC MOTORS.

THE WORLD'S COLUMBIAN EXPOSITION—THE TRAVELING SIDEWALK NOW IN OPERATION.

change is felt in stepping from the slow to the faster moving platform, on which are stationary cross seats. There are gas pipe posts at intervals of 12 feet on the slower moving platform, for the convenience of any one desiring such assistance in stepping from the stationary platform.

In this construction it will be noticed that the moving sidewalk and the sidewalk car do not stop at all, the differential speed allowing the passenger to readily and conveniently get off at any time, while the travel of the car is continuous, motors, each handling 25 platforms, the platforms being each 12 feet long, and each connected with its predecessor and trailer by an ordinary pin coupling. The current is conveyed by a trolley wheel and pole from the feed wire beneath the platform, the return current being through the rails. The greatest speed which has been attained on this test structure is eighteen miles an hour. The cost of constructing a sidewalk railroad of this kind is evidently far less than that of the usual elevated railroad, and, as there are no stops, the

power required to operate it would probably be much less than half of that of the present system for the same volume of traffic. The section now running is said to be practically noiseless.

THE ERECTION OF MUNICIPAL ELECTRICITY WORKS AT MELBOURNE.

[FROM OUR OWN CORRESPONDENT.]

THE municipality of Melbourne has decided upon the erection of a municipal central station for the supply of the public lighting of the streets of the city. The electricity works to be erected by the municipality will serve exclusively for the supply of the public lighting, as the City Council does not wish to compete with the existing electric lighting companies, thus leaving the supply of electricity for private lighting entirely to private undertakers.

The whole installation will comprise 633 arc lamps of 1,200 C.P. each, and 1,200 incandescent lamps of various C.P. (from 20 to 32), and is to be installed upon the "series arc and incandescent systems," described in the official report of the electrical engineer as "offering a great flexibility of distribution, being distinct from all other systems in this respect." In the same report the series system is said to be superior to the parallel arc system, as, "in all parallel systems, a fall of pressure of electricity takes place at the outlying districts, thus reducing the candle-power of the lamps considerably, whereas in the series system every lamp (whether close to the generating station or five miles from it) has the same candle-power."

Tenders are now invited for the supply of the necessary machinery, lamps and accessories, on the following specification and conditions:

Dynamos.—To be of approved make and design, to be continuous current suitable for running arc and incandescent lamps in series, capable of running from 50—60 1,200-C.P. lamps, speed not to exceed 1,000 revolutions per minute. To be both mechanically and electrically well constructed, having large surface for bearings and perfect lubrication. To be fitted with regulators to maintain a constant current.

Arc Lamps.—To be of latest design and make; to run without recarboning for 16 hours; to be nominal 1,200 C.P. each complete with globes of clear glass.

Hanging Boards.—One to be supplied for each arc lamp; to be fitted with switch for short circuiting lamp when necessary.

Hoods.—One hood of neat and serviceable design to be supplied for each arc lamp, to which attachment can be made for suspension of lamp.

Series Incandescent Lamps.—Series incandescent lamps to be of the following C.P.'s:—20-25-32, capable of taking the current used on the arc circuit, and guaranteed for 1,000 hours burning, and so constructed that in the event of the filament breaking, the current will find an easy passage through the lamp.

Series Incandescent Socket and Shade.—To be of design suitable for out-door work, including inverted tin shade and glass globe to protect the lamp from moisture and mechanical injury.

Instruments.—Ammeters to be supplied for each dynamo, capable of reading up to double the normal current of the machine; to be of approved and reliable make.

Switchboards.—To be of suitable make for arranging circuits as desired with plug connections; to be mounted on incombustible bases.

Lightning Arresters.—Lightning arresters of approved make to be supplied for dynamo circuits.

Tenderers are to supplement the schedule hereto, with any articles not mentioned therein, but which form part of or are necessary for the satisfactory working of the system of lighting proposed to be supplied.

Materials and workmanship of the best quality only to be utilised in the carrying out of the contract.

The quantities set out in the schedule are as near as can now be estimated the quantities which will probably be required, but the contractor is to supply any greater or lesser quantity which may be required at the prices set against each item in the schedule.

CONDITIONS OF CONTRACT.

Time for Completion.—The whole of the plant to be delivered f.o.b. at port of shipment in first-class order, before the expiration of—— weeks from the delivery of notice of acceptance of tender as provided for in condition of tender attached thereto.

Damages for Non-Completion.—Should delivery not be given within the time specified, the contractor shall pay to the corporation for every week or part of a week thereafter, until such delivery shall be given, the sum of £25, as, and by way of liquidated damages and not in the way of a penalty, and such monies for said damages may be deducted by the corporation out of any monies due, or that may become due to the contractor on account of this contract.

Inspecting of and Testing of Plant.—The whole of the plant must be submitted to the inspecting officer of the council at the premises of the contractor, to be tested by him in such manner as he may think necessary, and particularly as to insulation, efficiency, regulation and mechanical and electrical construction, and such plant must be certified to as satisfactory by such inspector before delivery thereof will be accepted.

Should the contractor fail to construct any portion of the machinery in accordance with the foregoing specification, either as to material or workmanship, the inspecting officer of the council may at any time prior to his giving his certificate of completion of this contract reject such portion of the machinery, notwithstanding the same has previously been passed by him.

Claims for Patents.—The contractor shall at his own cost supply all such machinery free from all charges or claims with regard to royalty on any patented article, and any claims that may be made in respect to the patent rights of any articles supplied by him in accordance with this specification which may be used in connection with his scheme in executing this contract.

Delivery.—The plant to be properly packed and delivered f.o.b. at port of shipment, inclusive of all charges up till such delivery including insurance of the plant, but not including freight.

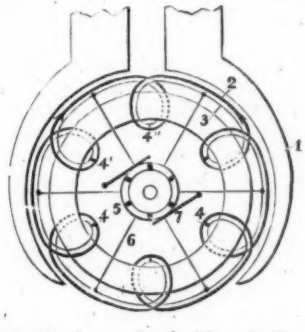
Payment.—Payment will be made by the council to the contractor in manner following, viz.:—75 per cent. of the amount of his contract upon receipt by the council of bill of lading for such plant, and the balance of 25 per cent. 60 days after sight of bill of lading, such balance to be in the meantime subject to any claims which the council may have against the contractor in respect of this contract.

Arbitration.—In the event of any dispute arising between the council and the contractor in reference to any matter or thing connected with or arising out of this contract, such dispute shall be referred to and decided by arbitrators, one to be appointed by each party and an umpire to be appointed by the arbitrators, and the award of such arbitrators or any two of them shall be final and binding upon both parties to this contract.

Interpretation Clause.—The word "council" shall mean the Council of the City of Melbourne. "Contractor" shall mean the company, persons, or person who shall undertake the carrying out of this contract. "Inspecting officer" shall mean the person appointed by the council for the purpose of inspecting and testing the plant contracted to be supplied. "Electrical engineer" shall mean the person for the time being holding the office of electrical engineer to the council.

EDISON'S METHOD OF REDUCING SPARKING AT THE COMMUTATOR.

THIS improvement, says *Electricity* of New York, is described in the present instance as being applied to the armature in the form of a Gramme ring. Instead of winding a single wire on the armature core, as usual, Mr. Edison winds two or more conductors at the same time. Of the two wires thus wound, one is preferably a coarse copper wire and the other is a fine wire of a metal having a higher specific resistance, such as German silver. The latter conductor is employed particularly as a resistance wire, while the former is the wire which carries the larger part of the current generated in the machine.



The drawing will give a clearer idea of the method: 1, 1, are the two poles of a field magnet, 2, is the insulated copper wire of the armature, and, 3, is the insulated German silver resistance wire. At the centre of each section of the coil of the armature ring the copper and German silver wires are electrically connected, as indicated at 4. The armature coils are connected to the segments of the commutator, 5, by German silver or other wires, 6, leading from a point approximately midway between two of the connections, 4.

Assuming that the armature is used in a dynamo, the operation may be explained as follows:—As the armature is rotated, current is generated in opposite directions in the two sides of the armature, and these currents meet approximately over or above the commutator, the direction of the current being indicated by arrows. When the current on one side

reaches the section between the points, 4′ and 4″, it will pass across the connection at 4′, to the German silver wire, 3, and thence to a commutator segment and commutator brush, and the current on the opposite side of the armature will pass across at 4″ to the German silver wire, and thence to the commutator, thus putting a section of the resistance wire in circuit and reducing the sparking at the commutator when the brushes pass from one segment to another.

It is not essential that the two wires be wound together for the whole length or that they should be wound together at all, and conductors of other materials than those mentioned may be employed. It will be evident that current will also be generated in the resistance wire, which current will be in the same direction as that in the copper conductor.

PROF. FORBES ON THE DEVELOPMENTS OF ELECTRICAL DISTRIBUTION.

SECOND CANTOR LECTURE.

THE second lecture of Prof. Forbes was listened to on Monday night, at the Society of Arts, by as large an audience as attended the previous discourse. The lecturer, in his opening remarks, urged the importance of not slurring over actual difficulties that were before them in the matter of distribution. They were looking at the question of distribution from an engineering point of view, and it was desirable always to face the difficulties, and to see their way, rather than pretending they did not exist. In his previous lecture he pointed out the chief causes of excessive expense in distributing electricity through towns. There is, first, cost of distribution, and second, cost of generation, and in both cases expense of production and distribution was greater than it would be if they were producing electricity for their own purposes at a constant rate. The want of regular distribution injured them in two distinct ways: first, through their engines, and second, through the boilers. Owing to the fluctuating demand for light, they were compelled to vary the number of engines to supply the mains, and this necessitated engines running often below their economical load; there was also a great amount of coal burnt in heating the boilers up for the two hours' run. Few people, in the lecturer's opinion, realised what an enormous loss there was where they were running powerful engines at light loads, more especially compound engines. Of course that difficulty could be surmounted by employing tolerably small units; but with respect to boilers they were without remedy at the present time. Great attention was given to this point by Mr. Crompton in a paper read before the Institution of Civil Engineers, in which he introduced the term "Load Factor." The "Load Factor" was very important, but an important thing in connection with this was that no one exactly knew what it was. Mr. Crompton introduced five distinct definitions of the load factor, each of them giving totally different meanings. He would endeavour to give them a series of definitions which he trusted would suffice for all future purposes; he had hoped before this that Mr. Crompton would have given them an exact definition, but he had failed in that, and therefore he (the lecturer) would give what he thought would suffice for engineers. Prof. Forbes here drew attention to the diagrams illustrating the load curves of the Berlin Station. Coming again to the question of load factors, he said Mr. Crompton tried to indicate by this the ratio of the average quantity of electricity to the maximum, but what maximum was to be chosen was not defined. He, the lecturer, proposed to adopt three distinct definitions: the machinery load factor, the current load factor, and the temporary load factor. The machinery load factor for days, weeks, months, or years, meant the ratio of the average current during that period, to the maximum current of which the station is able to give out. By the current load factor for any day, week, month, or year, he meant the ratio of the average current during that period, to the maximum current which was required during any part of the year; and by temporary load factor, he meant the ratio of the average current in any day, week, or month, of that period, to the maximum which is used during that period. If they adopted those three, he thought they would be sufficient for all purposes.

HIGH PRESSURE SUPPLY.

It was obvious from the very earliest attempts of low tension distribution, that there would be considerable loss if they attempted to increase the distance. The remedy for the difficulty lay in the use of high pressure which involved small wires, at any rate for long distances. There were two attempts made in this direction, one was by means of storage batteries, and in his previous Cantor lecture in 1885 he gave an account of such an attempt which had been made in Colchester. That scheme, however, died from various causes, one being that the batteries employed were not thoroughly reliable. An exactly similar scheme had since been worked out in Chelsea by the engineers who superintended the Colchester system. Here they had an example of storage batteries put into sub-stations which were charged in series by high tension mains, and which then discharged into the houses by independent low-pressure mains. That system, as the result of working some time, might be considered in many ways satisfactory, the only serious objection, perhaps, being the cost. The other method used was an arrangement of parallel series distribution; lamps and mains were divided into groups, each group was put in parallel and the successive groups were put in series; it would therefore be possible to have a dynamo working at 400 volts, and there would be five main wires in the distribution; the lamps would, of course, be placed between the first and second, third and fourth, and so on. By this means each group of lamps, of which there were four, would only be taking its 100 volts, while the dynamo was giving off 400 volts; they would thus be able to go four times the distance that they would in ordinary distribution, and twice the distance of the three-wire system. That system had been adopted in several places abroad, and so far back as 1885 had been used at Temesvar, in Hungary. The most notable was, perhaps, the Sector Clichy,* in Paris. The difficulty in this system was when, at any time of the day, the number of lamps on the different groups were not equal, the group using the fewest lamps would be too bright, and the groups using the greatest number of lamps would be too dim. Various attempts had been made to get over this trouble, and he, the lecturer, at the Cantor lectures of 1885, showed an arrangement of automatically switching lamps from one set of mains to the other, which, however, was too complicated to be of much use. Another plan which had been introduced in the Sector Clichy, Paris, was to introduce in different parts of the network what was called a compensator which consisted of four dynamos, each machine being connected to one of the four groups. In the case of a group requiring full pressure the dynamo acted as a generator, but in the groups where there are few lamps it acts as motor absorbing the current. This, however, was not a satisfactory arrangement, and was moreover very wasteful, and the directors of the Sector Clichy are about to abandon the method. The alternative to which they had been driven was to use batteries of accumulators to act as regulators. Fifty cells are placed in different parts of the mains, between each of the pairs of mains, in parallel with each group of lamps. The batteries will thus maintain the pressure, and if there are too few lamps between the groups, the current will pass through the batteries and charge them up. The method behaves well, but batteries were of course an expensive item, and if there were a more economical system it would be preferable. They would notice that this system was analogous to Hopkinson's many wire system, an extension of his three-wire system, patented by Hopkinson and Edison simultaneously. The difference is that in Hopkinson's there is not a dynamo of 400 volts, but four dynamos each of 100 volts.

Coming to other high pressure systems, the most important, and the one which had received the greatest developments, was the alternating current transformer system. The convenience of this was enormous; they were able to send an alternating current through an extremely fine wire to a great distance; in fact, a main of the twentieth part of the section required in the low-tension system.

It was, of course, dangerous to bring high tension currents into the houses, but a properly constructed transformer gave them the utmost immunity from danger, and effectually

* This has been fully described in previous numbers of the REVIEW.—EDS. ELEC. REV.

prevented the high pressure currents from entering the houses. He regretted that was not always done in practice, but there was no excuse for bad work in that way. The alternate current was peculiarly suited in another way to distribution, and that was a point which had not been sufficiently attended to in the past. The method which he had suggested was about to be adopted in the City of London lighting. They would remember, when lecturing last week, that he showed there was some difficulty in regulating the pressure in the low tension systems, but there was not the slightest difficulty in that way with alternating currents. That could be done by using a choking coil; by this means they were able to reduce the E.M.F. on the feeder without consuming energy. Another method that was also equally applicable was, when the current was passed through a transformer in the central station they could take off the current from the whole of the secondary coils in the transformer; they might, by adjusting it, take off current at 100 volts, or any other voltage required. Those two methods would be, in the future, of the utmost importance in alternate current distribution. The alternating current had been objected to on a great many different occasions by those who were interested in supporting low tension, and by those who did not fully appreciate the merits and advantages of the alternating current. There had been certain disadvantages connected with it, but he hoped to see them removed.

The Use of Alternating Currents for Motors.

The first important difficulty that they need pay attention to was that hitherto alternating currents had not been suitable for driving motors. This, however, was not so serious a difficulty as it looked at first sight. The experience gained, where motors had been put on lighting circuits, had not always been favourable to that arrangement, and in many central stations it had been found desirable to have separate machinery, and separate distribution mains for motor circuits. When motors and lamps were on the same circuit, sudden heavy work put on the motors made the lamps dim. In a motor system of distribution, the regulation of pressure to a very great nicety was not of such great importance, but in lighting it was of the utmost importance. The chief reason for putting motors on, was that it was thought the motors would improve the load factor, but it was not the case, for the two were bound to overlap at the time of busiest working. He believed that in the future development of central stations by means of the alternating current, they would have entirely got rid of these difficulties. Another difficulty which really needed remedy was in electro-chemical operations. In this case the alternating current was not very suitable. Of course, they could not charge batteries, nor could they use the alternating current in electro-deposition; but it was generally for such purposes cheaper to generate electricity direct than to take it from a supply company. As to storage batteries, it was very convenient to be able to charge storage batteries; but so long as they did not require any reserve power, the necessity for storage batteries diminishes, and as the result of very great experience in the past, they were improving every year in the certainty of their supply, so that at the present moment there was really an infinitesimal number of central stations being called upon to supply electricity from storage batteries, and every year the possibility of such a thing was diminishing.

Sub-stations *v.* House Transformers.

He had said that there would be some considerable changes in their methods of distributing electricity by means of the alternating current, and the greatest alteration which he expected to take place would occur in the introduction of sub-stations. Up to the present time it had been the custom, when using alternating current, to put transformers in the customers' houses; but it was somewhat costly to make separate transformers; it was also not convenient to put transformers in the houses, for the reason that it was difficult to regulate the pressure, so as to keep the pressure perfectly constant at all hours, because in addition to the changes in pressure owing to the distribution, they had actual loss in transforming, and although the greater part of this loss was constant and did not affect the distribution problem, there was a certain amount variable with the load. If they introduced sub-stations where the pressure could be regulated, and where low tension was then distributed, they had a means of regulating the pressure, which could be done by an attendant in the sub-station, provided that they made them large enough to make it worth while to employ an attendant. There was not the slightest doubt that they would be able to do this in another manner, and to make the transformers self-regulating to a certain degree, so that it would be possible to place large transformers in underground vaults, or in places where they only required very occasional inspection. There had been several inventions made in this direction, and he had hoped to have shown some of the latest arrangements of Mr. Ferranti, but a little difficulty with foreign patents prevented this. It would be seen that it was possible to arrange an automatic switch so that when the demand for current was great, an additional transformer could be switched into the circuit, and when the current fell off the switch would act in the opposite direction and put in a smaller transformer. It was also possible to wind the primary and secondary cores of the transformers with more than one wire, and to have an arrangement by which the primary and secondary coils could be put in series or parallel, simultaneously, according to the different demands for current, that would also get over their difficulty. The effect of such changes would be to make the dynamos work at economical load. There was always a hysteresis loss in a transformer, and that loss was fairly constant whatever the demand for current might be, but by proportioning the size of the transformer to the load required, they were able to make the hysteresis loss a small proportion of the total current required to keep the transformer working at efficient load. Under the present arrangement of a transformer in every house, they were working in a very inefficient manner during the time when the load is light, and during the day time when no current is being taken at all; but with the sub-stations supplying the secondary low tension current to the mains, there would be a very small number of transformers at work during the hours of light load, consequently they might look for an efficiency of 90 per cent. during the whole 24 hours. The feeling among engineers at the present time was, that sub-stations ought to be introduced instead of the house transformer, and they could look with certainty to this result in every large system of transformer distribution. If they were going to introduce the system of sub-stations, it became necessary to review the whole of the system of distribution and see whether they were working in the right direction. There was one point requiring radical modification, the frequency of alternations. To carry out the work economically, the pioneers of electric lighting used small transformers, with high pressure of 1,000 volts. To do this they used dynamos which gave very rapid alternations; the result was a considerable rise of energy in the hysteresis of the transformer. When they came, however, to use sub-stations, the economy to be gained by using high frequency was not nearly so large, for that reason it would be desirable to reduce the frequency of their alternations as low as the frequency in an ordinary continuous dynamo armature; that is, reduce from 130 periods per second down to something like five or ten periods per second. When they had a secondary main of a large section it was with difficulty they could force a current of high frequency through. Such a current had a remarkable effect on the conducting qualities of large conductors; the current was forced into the outside of the conductor, and made the inside of the conductor almost useless as a means of carrying the current. It was only by diminishing the frequency of the alternations that they would be able to get over the very serious trouble which would arise as soon as they had low tension mains carrying alternating currents. Low frequency currents at once solved the problem of the electro-motors. They knew perfectly well that alternating current motors were being developed which were said to be far superior to the continuous current motors, and consequently the development in this part of the subject would be in the types of motors, which had attracted so much attention elsewhere. Even in these motors, however, low frequency would be an advantage. Low frequency would also enable them to introduce a commutator in such a way as to convert alternating current into a continuous, by this means enabling them to charge storage batteries. Other systems of high tension had been proposed, the most important of which was the continuous current transformer. These combined

machines were of the highest efficiency, owing their value to two sets of winding annulling the armature reactions. Although high pressure electricity was perhaps the most economical means by which they could transmit power from one place to another, there were several means which were worthy of consideration, such as compressed air, hydraulic pressure, and gas, and he begged electrical engineers not to cast aside as utterly useless these other methods. Speaking of power obtained by gas, the lecturer said the Dowson gas was extremely economical, and the question came in here whether it was ever economical to introduce gas engines in sub-stations instead of steam. Personally, he had no hesitation in saying that in many cases they were most economical, and as the demand arose for larger engines of this class, so would they be made. The question of gas engines had attracted the attention of engineers, and in designing central stations in the future, the matter would not be lost sight of. The lecturer concluded by referring to the systems of laying mains, which, however, are well known to our readers.

NOTES.

Electricity and Agriculture. — Several enterprising agriculturalists in this country have from time to time made experiments with electricity as a motive power in agriculture; but none of them has ever been able to show that it could economically replace horsepower or even steam. Perhaps this has not been the fault of electricity, but rather of the methods by means of which it has been applied. At least, no one dare predict in these days, when it is as frequently the unexpected that happens, that electricity will never be seen on the farm taking the place of the threshing engine or the ploughman's team. English farmers have already learned a lot from the Americans; many of their most useful machines are of Yankee invention, and they have still more to learn from their transatlantic cousins, who seem likely to be the pioneers of what may be termed farming by electricity. Mr. A. Denton of the United States Department of Agriculture is a firm believer in the ultimate employment of electricity in the agricultural operations of the western states where everything is on an extended scale. He is prepared to give the greatest possible encouragement to inventors who will turn their minds in this direction. Speaking on this subject, a short time ago, he said that agriculturists were awaiting with impatience the assistance which electrical engineers can lend them. Here is a chance for those who are ever complaining that everything is so crowded and that they cannot find scope enough for their energies. There is plenty of "fresh ground to break" in applying electricity to the requirements of agriculture.

To Keep Iron Pipes from Rusting.—The following simple and economical way of tarring sheet iron pipes, to keep them from rusting, described in the *Scientific American*, is well worth notice, and is as follows:—"The sections as made should be coated with a coal tar and then filled with light wood shavings, and the latter set on fire. It is declared that the effect of this treatment will be to render the iron practically proof against rust for an indefinite period, rendering future painting unnecessary. In proof of this assertion, the writer cites the example of a chimney of sheet iron erected in 1866, and which, through being treated as he describes, is as bright and sound to-day as when erected, though it has never had a brushful of paint applied to it since. It is suggested that by strongly heating the iron after the tar is laid on the outside, the latter is literally burned into the metal, closing the pores and rendering it rust proof in a far more complete manner than if the tar itself was first made hot and applied to cold iron, according to the usual practice. It is important, of course, that the iron should not be made too hot, or kept too hot for too long a time, lest the tar should be burned off. Hence the direction for the use of light shavings instead of any other means of heating.

Chicago Exhibition, 1893.—A *Times* correspondent telegraphs from Melbourne, stating that the Victorian Government has decided to grant £15,000 towards the Chicago Exhibition, provided that the exhibitors themselves subscribe £5,000.

The Electric Light in the Royal Navy.—The officials at Sheerness Dockyard have received instructions from Whitehall to prepare an estimate of the cost of fitting the electric light on the gunboat *Trent*, gunnery tender to the flagship *Wildfire*. The *Trent* is to be taken in hand shortly at Sheerness for her annual refit.

A Simple Heat Engine.—Under this heading, a correspondent, writing to *Nature*, describes a modification of Mr. Shelford Bidwell's experiment, illustrative of the fact that nickel ceases to be magnetic at a certain definite temperature. The new experiment consists of a nickel disc, close to the periphery of which are the opposite poles of an electro-magnet, these poles being at points on the disc distant 90° from each other. On heating the edge of the disc close to one of the poles of the electro-magnet, the disc revolved. With reference to this experiment, we may remark that it can be performed with a soft iron disc; in fact, this latter experiment was described several years ago in the pages of the *English Mechanic*, and is therefore no novelty.

Electric Light in Brussels.—It is sometimes said that electric lighting schemes progress more rapidly on the Continent than in England, especially when in the hands of municipal authorities; but even if this is so, the pace does not always become a killing one, if we may judge from the hope expressed in the last paragraph of the following extract from the *Bulletin International de l'Electricité* relative to the lighting of Brussels:—"The question of electric lighting is apparently progressing, and may shortly be expected to be further discussed before the Municipal Council. There are in all six tenders which are being examined by a committee of experts with M. Wybauw at their head. This work is nearly complete, some further details of the working of the proposed installations only being required, and these the competing firms have been asked to supply at once. The administration propose to commence with a plant capable of supplying 10,000 lamps in winter, and 5,000 in summer, in addition to 200 arc lamps required for the Parc and boulevards. There is therefore still hope that we may see the Belgian capital lighted by electricity before the end of the century." It is no wonder that the would-be users of the light show some impatience, as the Municipal Council of Brussels have been considering the subject for two or three years; and even now, having drawn up an elaborate specification in April of last year, they have, it would seem, only got so far as to have the report of their experts nearly ready for presentation. It is, however, satisfactory to hear that progress is being made, and it is to be hoped that the remaining stages will be successfully passed, and that there will be no disagreeing on reports, or, worse still, issuing of fresh specifications, which cause so much loss both in time and money to the competitors. Such experiences are not altogether unknown when municipal bodies, who are owners of the gasworks or are otherwise interested in delaying matters, wish to defer the execution of the work, and we sincerely hope that no such influences are at work in Brussels, but that one of the competitors may be speedily entrusted with the work, and that the inhabitants of the Belgian capital may have the benefit of electric light whilst there are still several years of the present century left to enjoy it in.

Edison's "Water-baby."—There is a funny man on the *Globe*, as well as a "scientist;" and of the two, the former is, in our opinion, the more successful, especially when dealing with matters scientific. Last week we gave a specimen "par." showing what the "scientist" can do when he tries. This is how the funny man deals with the same subject. [*Vide* the *Globe*, January 30th.] "Mr. Edison's new invention—the electrical water jet—which is to revolutionise warfare, is christened by a French writer *le clysopompe*, which is decidedly soothing. We had already thought of the hydropult; or, inasmuch as it is to supersede our Woolwich infants, it might be called Edison's water-baby," with, we may add, we presume apologies to the immortal Kingsley. In future, we should advise the "scientist" to collaborate with the "funny man," and he will then at least succeed in making the "Science Echoes" more readable.

An Edison System of Distribution Patent.—On December 8th, 1891, a patent (American) was issued to Mr. T. A. Edison, entitled, "System of Distribution," No. 464,822, which the Edison Company claims to cover the placing of converters or transformers in multiple arc. The patent was filed June 26th, 1882, and describes the method of employing a high tension main circuit extending to a distant point, and "tension reducers" located at a distance from the point of supply and connected with the high tension circuit in multiple arc so as to be independent of one another, the lamps or motors on the derived low tension circuit also being connected in multiple arc. One method of accomplishing this object is described, consisting of secondary batteries or condensers which are charged in series from the high tension circuit and discharged in multiple into the low tension circuit, this being accomplished by means of a revolving commutator. The patent has been the subject of prolonged interference proceedings.

The Electro-Harmonic Society.—We are assured that Mr. Nikola Tesla has determined to be present this evening, so a full muster of members and friends is almost certain.

Registered Telegraphic Addresses.—From the *Times*, we learn that some prominent members of Parliament, both Conservatives and Liberals, have decided to take up the case of Mr. Henry Sell against the Post Office. It appears that 40,000 merchants have registered their abbreviated telegraphic addresses at the General Post Office, each paying £1 1s. per annum for the privilege, and it would admittedly be of great public convenience to have these addresses printed and sold to the public at a cheap rate. Mr. Sell has collected and published for some years a directory of them; and he alleges that, if the Post Office would supply him with addresses not yet included in his collection, he would be able to publish a complete list at a very low price. For some unknown reason the officials refuse him all assistance. Mr. Sell made a final application, backed up by a petition signed by numerous firms of the very highest position, but was again unsuccessful. It seems that, after rejecting Mr. Sell's request, the postal authorities sent out proposals for the issuing of an official list, but failed, and had to abandon all idea of publishing one. The matter is now to be fought out in Parliament.

The Three-Phase System at Heilbronn.—The first practical introduction of the three-phase or "drehstrom" system for electric lighting has taken place by the inauguration on the 16th ult. of the Heilbronn central station. The motive power is derived from that portion of the water of the river Neckar belonging to the Wurtemberg Portland Cement Works at Lauffen. The turbines were made by the Geislingen Engineering Works, the dynamos and transformers by the Oerlikon Works, and the cables by Messrs. Siemens & Halske. At present about 330 H.P. is being transmitted from Lauffen to Heilbronn, a distance of about 7½ miles, whilst later on it is intended to transmit 1,000 H.P.

Weston's Temperature Compensator.—From our contemporary, *Western Electrician*, we understand that Mr. Edward Weston, of Newark, N.J., has designed a device "for the purpose of maintaining constant the electrical resistance of a circuit, despite changes in temperature." A perusal of the description of this temperature compensator, given by our contemporary, convinces us that Mr. Weston's "latest invention" is absolutely identical with that devised by Mr. T. E. Gatehouse some 10 or 12 years ago. "There is interposed in the circuit of the fixed coil a body of carbon or other material, which possesses the property of offering a diminished electrical resistance on being increased in temperature. This carbon is proportioned so that a temperature variation, which will produce a certain increase in resistance in the coils, will produce a corresponding decrease of resistance in the carbon body, and in this way the resistance of the whole circuit is kept constant." It is curious that a gentleman of Mr. Weston's attainments should have overlooked Mr. Gatehouse's suggestion.

Electric Light in Santa Fé.—The *Financial News* states that the electric light in Santa Fé has proved a failure, and the municipality has returned to kerosene.

Communication with Lundy Island.—Owing to the accident which happened to H.M.S. *Banterer* in Bideford Bay, attention has been drawn to Lundy, and surprise has been expressed that an island in the middle of an important channel and a much-frequented harbour of refuge should be without means of prompt communication with the mainland by telegraph cable or otherwise. A cable was laid early in 1884, but the company did not succeed, and the cable was sold. It is generally admitted that communication should be established, but the question arises whether the work should be carried out by the Post Office authorities, the Admiralty, or by a public company.

The Electric Light in the Isle of Wight.—At the meeting of the West Cowes Local Board last week, a report was submitted from the Special Lighting Committee recommending that the license applied for by the Isle of Wight Electric Lighting Company be approved by the board. It was stated that the schedule of prices had been furnished. It was proposed that the matter be deferred for a month, and that in the meantime the members be supplied with a copy of the license.

Pontypool Lighting.—The Pontypool Gas Company, in consequence of the recent cry raised by the inhabitants of the town against the inferior quality of the gas, and the proposal of a private syndicate to introduce the electric light, are drafting a Bill in Parliament to enable them to construct additional works, to abandon works authorised in 1890, and to extend the time for the compulsory purchase of land.

Electric Lamps for Omnibus Inspectors.—The London General Omnibus Company has supplied all their ticket inspectors with small electric lamps with which to see the number of the passenger's ticket. This will, perhaps, have to be extended, because the conductors complain, says the *Daily Chronicle*, that they having no light are not able in the dark thoroughfares to see to punch the tickets properly when on the roof of the vehicle.

The Proposal to Light Aberdeen by Electricity.—The members of the Gas Committee of the Town Council have been placed in possession of prints containing copies of all the documents and a record of the proceedings before the Town Council in connection with the proposal to light the city by electricity. The print has been issued with the view to the consideration of the whole matter at a special meeting of the committee to be held on an early date.

The Electric Lighting of Larne.—On Thursday night last week, a memorial was presented to Mr. John Fullerton, Chairman of the Larne Town Commissioners, requesting that a public meeting of the ratepayers of the town of Larne should be called on Thursday next in the M'Garel Town Hall, Larne, in order to take the minds of the ratepayers and give expression to the unsatisfactory state of lighting of the town of Larne, and also to consider the 42 years' agreement entered into between the commissioners and Messrs. J. E. H. Gordon and Company, Limited, London. Mr. Fullerton readily complied with the wishes of the memorial, which bears 109 signatures, and a town meeting is being arranged for.

The Electric Light at Coventry.—The Electric Light Committee of the Coventry City Council announce a report from Mr. A. B. Holmes, the engineer who advised the Corporation in the promotion of the provisional order. The report, in answering several points put to Mr. Holmes, states that for undertaking the supply of electricity themselves the Corporation have several marked advantages, and could supply the light at lower rates than it is possible for a company to do. Mr. Holmes recommended a low tension direct current system of supply, with underground mains. The estimated cost is £32,000, and he states no advantage is to be gained by delay in commencement.

Electric Lighting of the London School Board Offices.—At the weekly meeting of the London School Board, we understand that the Board authorised an expenditure of £3,600, exclusive of the cost of fittings, for providing electric lighting, for the offices of the Board.

Personal.—Mr. Thomas Parker, of the Electric Construction Corporation, was, on Monday evening elected a member of the Royal Society of Edinburgh.

Mr. Rollo Appleyard has resigned his position at Coopers Hill College, and entered the submarine department of the India-Rubber, Gutta-Percha, and Telegraph Works Company.

Royal Institution.—The lecture announced to be given by Mr. Nikola Tesla at this Institution was delivered on Wednesday, the 3rd inst., before a large and appreciative audience. The experiments shown, most of which have already appeared in our pages, were of a brilliant and remarkable character, though the deductions to be obtained from the same were but briefly touched upon.

The Right Hon. Lord Rayleigh, F.R.S., will on Saturday, February 13th, begin a course of six lectures on Matter: at rest and in motion.

Hindrance.—*Industries* states that the latest electrical term is "hindrance." Our contemporary has already had correspondence with a foreign gentleman who called resistance "Hinderness," a term which seems much better. If hindrance is a velocity, perhaps the velocity of evolution of new terms is also a hindrance to science.

The Electric Light in Canada.—Electric Lighting has made great progress during the last few years in the province of Ontario, Canada. There are now 12,000 arc lamps, and 33,000 incandescent lamps in use in the province, together with 3,500 miles of electrical circuits, 400 dynamos, and 200 motors.

Bristol Electric Lighting.—The Bristol electrical committee report that it will be necessary, with a view to securing stability for the chimney stack and walls of the central electric lighting station, and freedom from vibration for the machinery, to pile the whole of the site of the building, and to construct concrete foundations. The committee have advertised for tenders for doing the work, and they recommend that the tender of Messrs. J. Durnford and Son for £6,670 6s. 6d. (being the lowest received), be accepted, and that a contract be entered into with them accordingly.

The Electric Light at Cornsay Colliery.—We learn that Messrs. Ferens & Love have put down an enlarged and extended installation at their Cornsay Colliery. They have erected a powerful dynamo, made by Messrs. J. G. Statter and Co., of London. The installation comprises the lighting of pit heap, screens, coal-cleaning tables, engine houses, and mechanics' shops, with 25 C.P. incandescent lamps, and pit heap and cokeyard gangways with 200 C.P. Sunbeam lamps.

Llandaff City and Electric Lighting.—From the *Western Mail* we understand that a meeting of influential residents was held a few days ago, when steps were taken for the establishment of a station in the City. It was proposed to build premises and erect plant at Ely, about a mile distant from Llandaff. Estimates for the purpose had been obtained from a London firm of electrical engineers, who consider that an efficient plant can be put down for the sum of £4,000, which sum, of course, does not include the cost of wiring houses, and providing electroliers and other fittings.

Indian Telegraphs.—The following appeared in the *Gazette*, of India:—"Military Department, Field Operations, Hazara. The telegraph service was conducted with the greatest efficiency by Mr. R. C. Barker, C.I.E., and a very capable staff. Mr. Barker is an officer of marked ability and energy, and he succeeded in inspiring the whole department with his own good qualites. The organisation of the field telegraph now leaves little, if any thing, to be desired. The incorporation of the military telegraphs with the Telegraph Department of India has been shown to work successfully in the field, both as regards *materiel and personel*. The rapidity with which lines were laid down behind advancing columns, over very difficult ground, and taken up when no longer required, augurs well for the successful construction of field lines in more ordinary conditions of warfare."

Electrocution.—Our American namesake states that two more murderers, McElvaine and Trezza, have been sentenced to be electrocuted on February 8th. A bill authorising the publication of reports on executions by electrocution has been passed by the American Senate. At the request of the Italian Government, Governor Flower has granted Trezza a reprieve, pending a further investigation of his case.

Sir William Thomson.—Our contemporary, *Western Electrician*, referring to the peerage conferred upon Sir Wm. Thomson by Her Majesty, gives a copy of an interesting and amusing letter from the London correspondent of the *Sun*:—"The greatest surprise in Queen Victoria's New Year's honours is the peerage for Sir William Thomson. His researches into electrical science have made for Sir William a world-wide name. Many of the electrical wonders which we marvel at now were foretold by him twenty years ago. Recently when Mr. Balfour delivered his rectorial address at the Glasgow University he was the guest of Sir William, and doubtless the conferment of a peerage is due to Balfour's initiation. Sir William is a genial, homely Scotchman. He is above suspicion. No amount of money could buy from him a favourable opinion for an unworthy object. He is slightly lame, and walks with the aid of a thick oaken stick. He dresses more for comfort than show, and his care of the bawbees is frequently illustrated by his contentions with London cabmen. He has a knack of ganging how far he can ride for a shilling to a mathematical nicety."

The Royal Society.—The following paper was announced to be read before this Society yesterday:—C. H. Lees, "On the Thermal Conductivity of Crystals and other Bad Conductors."

Electric Light at Swansea Docks.—The Swansea North Dock is now completely lighted by electricity, the innovation proving a great boon in comparison to the old style of illumination by oil and gas. Since this departure there has scarcely been an accident after dark, which speaks volumes in favour of the new system of lighting when the fact is considered that, previous to the installation, drowning fatalities at night were of very frequent occurrence.

Carmarthen Lighting.—At the last meeting of the Carmarthen Town Council, the question of better lighting the town was brought forward. It appears that the public lighting is very unsatisfactory, whilst the quality and price of the gas supplied are both outrageous. The report of the Lighting Committee recommended that advertisements be issued for tenders for lighting the town with oil, electricity, or any other illuminant, for one, two, or three years. Upon the recommendation being put to the meeting, however, it was lost on the casting vote of the Mayor, and consequently for the present matters have to go on as usual. As a large number of the inhabitants of the town are in favour of public lighting by electricity, it is stated that probably some steps will be taken to induce the Town Council to reconsider the matter.

The Telephone in Spain.—As no contractor has offered to undertake the installations of the telephone lines which are to join Madrid with *Cordone*, *Seville*, and *Cadiz*, the Spanish Government has undertaken the construction of these lines. Operations are to commence at once.

Telegraphs in the United States.—Copper wire is to be substituted for iron wire in the Philadelphia telegraph service. Copper wire weighing 210 lbs. per mile will be used. The iron wires hitherto used weighed from 380 to 450 lbs. per mile.

Dynamic Induction.—A student writes:—"I should be glad if some one of your readers could inform me how I could calculate the following:—A wire m metres long runs parallel to a similar wire also m metres long, the distance between the two being n millimetres. A current of A amperes is sent through one wire; how many coulombs, q, will be induced in the second wire, supposing there to be included in its circuit a ballistic galvanometer (of G ohms resistance) on which the induced dynamic discharge can be measured? I can find no direct or indirect reference to this problem, simple as it seems, in any book that I know of."

The Arcas Silver Plating Process.—We have received the following letter from Messrs. Paterson & Cooper: "In your description of the Arcas Silver Plating Process to be seen at the Crystal Palace, there occurs in the ELECTRICAL REVIEW of last week the passage . . . 'A Paterson and Cooper dynamo is used for the depositing, but this is about to be abandoned in favour of another form of dynamo.' As the publication of an unqualified statement of this kind is seriously prejudicial and likely to give a bad impression of our machines, we must ask you to kindly give the following letter, obtained from the London Metallurgical Company in reply to our enquiry, the same prominence in your next issue as was given to the description referred to."

[COPY.]

Messrs. Paterson & Cooper.

Gentlemen,—We have received your letter of even date. The reason we are abandoning the use of your dynamo for our Arcas Silver Plating, is not from any fault in construction, but owing to the different conditions under which we are now working. We have written a letter to the editor of the ELECTRICAL REVIEW, pointing this out. Yours truly,

(Signed) THE LONDON METALLURGICAL COMPANY, LIMITED.

[We would point out that no slur whatever was intended to be cast upon Messrs. Paterson & Cooper's dynamo, and regret that the statement was not more explicit.—EDS. ELEC. REV.]

The Liverpool Electric Association Football Club.—The above football club held their second annual dinner at the "Eagle" Restaurant, Castle Street, on Saturday last. The dinner was preceded in the afternoon by a football match between the married and single members of the club which the benedicts won by four goals to one, reversing last year's verdict when the single men won by five goals to *nil*. In the evening the party, numbering about 80, included Mr. A. B. Holmes, Managing Engineer of the Liverpool Electric Supply Company, Limited; Mr. B. H. Collins, Secretary; Mr. A. Clough, Works Manager; and Mr. Naftel, Chief Electrician. The dinner was followed by a miscellaneous entertainment. Mr. Collins proposed the toast of "Success to the Liverpool Electric Supply Company, Limited," to which Mr. Holmes responded, referring to the progress of the company since its formation and its present satisfactory condition.

The Electric Light at Portsmouth.—At a meeting of the Portsmouth Town Council on Tuesday, the electric lighting committee submitted a report, stating that since the presentation of a former report in reference to the scheme prepared by Mr. Shoolbred for an electric lighting installation in the borough, they had had reason to reconsider that scheme, and the recommendations based upon it, and they had obtained a further report on the subject of electric lighting from Prof. Garnett (an abstract of which has appeared in the ELECTRICAL REVIEW), which was submitted for the consideration of the council. As the result of further consideration, the committee recommended that the resolution of the council, passed on September 8th last, so far as it referred to the adoption of Mr. Shoolbred's scheme, be rescinded, but that this should not apply to so much of the resolution as referred to the borrowing of £60,000. The committee further recommended that the scheme and report of Prof. Garnett be adopted, that he be appointed as consulting engineer, and that Messrs. Waller and Manville be appointed as superintendent engineers, the fee for the consulting engineer and the superintendent engineers being £1,500 together. The committee asked for authority to acquire a sufficient site for the central station. It was stated that the cost of the scheme would be either £38,000 or £48,000, according to the engines it was decided to have, but this point would not be settled until a communication had been received from the Local Government Board. As an amendment to a proposal for the adoption of the report, Sir William Pink moved:—"That it be an instruction to the electric lighting committee to consider and obtain information as to the possibility of utilising tidal power for lighting of those parts of the borough contemplated in the provisional board, and to report to the council." After a long discussion the amendment was negatived, and the resolution for the adoption of the report carried by the casting vote of the Mayor.

Distribution of Power by Alternating Currents.—For the Description of the Stanley-Kelly motor we are indebted to Mr. Reginald A. Fessenden.

The Gospel by Telephone.—The National Telephone Company, Limited, Glasgow, have just completed the fitting up of an elaborate telephonic arrangement in Woodside Established Church, whereby the subscribers to their now extensive system are enabled to hear the entire service with the utmost distinctness and ease. It is quite a new feature in the progressive programme of the company in Glasgow, and one which ought to commend itself strongly to the religious fervour of the Scotch public, and greatly enhance the value and general utility of the telephone system.

Central Electric Stations in Europe.—According to recent calculations, there are at present 206 central stations in operation in Europe supplying current.

The Electric Light at Wurzburg.—It is proposed to erect a central electrical station at Wurzburg, in Germany, for lighting the town.

The Electric Light in Spain.—The authorities of the town of Tortosa, in Spain, are taking action with the view of putting down a plant for the electric lighting of the town.

Accident to an Electrician.—A Dalziel's telegram from Toronto on Monday last, states that Frederick Martin, the chief electrician of the Toronto Electric Light Company, while passing between two large dynamos recently accidentally touched them and completed the circuit. He was rendered unconscious, and is not expected to survive.

The Institution of Electrical Engineers.—On Thursday, February 11th, the ordinary general meeting will be held at 8 p.m., when a paper on "Some Experimental Investigations of Alternate Currents," by Alexander Siemens, Vice-President, will be read, and a discussion on above, and "On the Specification of Insulated Conductors for Electric Lighting and other Purposes," by W. H. Preece, F.R.S., Past-President, will be opened. A general meeting of the students of the above institution will take place on Friday, February 12th, when "Some notes on Electroplating" will be read by Mr. H. B. Little.

Researches on the Loss of Electricity caused by Very Refrangible Rays of Light.—Some time ago, Mons. Branley showed that the loss of positive electricity experienced by a charged metallic plate illuminated by very refrangible rays of light almost equals the loss when the plate is negatively charged (*vide Comptes Rendus*, April 8th, 1890). Physicists who had previously studied this subject had regarded this action of light as limited only to bodies negatively charged. According to Hallwachs, the loss of positive electricity is very small, being about $\frac{1}{100}$th that of the loss of negative electricity. And according to Stoletow (Congress of Electricians, meeting on August 30th, 1889), the loss is strictly unipolar, being limited to negative electricity. Branley succeeded in 1890 in demonstrating that losses of the two kinds occur when a source of light of full intensity, but very rich in ultra-violet rays, is used, *e.g.*, that afforded by the discharge of a Leyden jar connected up with a Rhumkorff coil fitted with a rapid contact breaker. He has recently been endeavouring to demonstrate that when every precaution against error that could be devised was taken, the positive loss was not negligible with respect to the negative loss. At the weekly meeting of the Academy of Science at Paris, Mons. Branley read a paper in which he gave a detailed account of his more recent experiments. In the research he used a special form of measuring apparatus, devised by himself, the illuminated and charged disc being mounted upon a delicate electroscope. Various metals were used for the discs, *e.g.*, copper, aluminium, magnesium, and the light employed was that emitted by an electric arc and also by a voltaic arc. The results showed that with the electric arc the loss of positive electricity from the charged plate is always revealed, whilst it decreases more than the loss of negative electricity does as the voltaic arc is made to wane.

The Electric Light at Montreal.—The Queen's Opera House at Montreal has recently been remodelled, and a complete installation of the electric light has been put in by the Edison General Electric Company. An electric organ blowing plant has also been placed in the church of St. John the Evangelist. The apparatus is worked by means of accumulators.

The Meaning of a Board of Trade Unit.—Professor J. A. Ewing, F.R.S., writing from Cambridge, says: "My attention has been called to a letter by Prof. Jamieson in the ELECTRICAL REVIEW of January 15th, in which he confesses himself "astonished" to find me speaking, in a recent report, of the rate of output of a dynamo as so many Board of Trade units per hour, or so many kilowatts. A little reflection should satisfy Prof. Jamieson that his astonishment has been a needless expenditure of emotion. There was no occasion for even the mildest surprise. Prof. Jamieson is joint author of a useful electrical pocket-book. If he will consult it, he will no doubt find that a Board of Trade unit is a quantity of energy. A little further research will lead him to the conclusion that one unit per hour is a rate of doing work, and that this rate may also be expressed by calling it one kilowatt."

NEW COMPANY REGISTERED.

Elmore's American and Canadian Patent Copper-Depositing Company, Limited. — Capital, £200,000, divided into 65,000 priority and 35,000 deferred shares of £2 each. Objects: To adopt and carry into effect an agreement already prepared and expressed to be made between Elmore's Foreign and Colonial Patent Copper Depositing, Limited, of the one part, Woodhouse and Rawson United, Limited, of the second part, and this company of the third part; to carry on in the U.S.A., Canada, and elsewhere, the business of manufacturers of and dealers in copper and other metals; to carry on the business of supplying electricity in all its branches, including that of electricians, electrical contractors, electrical and mechanical engineers, and manufacturers of electrical appliances. Signatories: J. Shurmer, 22, Ossory Road, S.E. (100 shares); R. J. Cox, 31, Railton Road, Herne Hill, S.E. (1); D. R. Allen, 2, Gordon Terrace, Sydenham, S.E. (1); J. J. Atkinson, Cosgrove Priory, North Hants (500); W. Elmore, Worcester House, Walbrook, E.C. (500); J. A. Ewen, 11, Bunhill Row, E.C. (500); F. L. Rawson, 3, Kensington Court, W. (500). The number of directors is not to be less than three nor more than nine, the first to be appointed by the subscribers. Qualification, £500; remuneration, £200 per annum each; an additional £200 for the chairman, and an additional £100 for the vice-chairman, together with 10 per cent. of the net profits after 30 per cent. per annum has been paid on the priority shares. Registered on the 26th ult. by Harry Ellis, 64, Cannon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Tanning Company, Limited.—The annual return of the above-named company, made up to the 1st ult., was filed on the following day. The nominal capital is £70,000 in £1 shares; 35,140 shares have been taken up, the full amount called, and £33,732 10s. paid, leaving £1,407 10s. unpaid. Registered office, 17 and 18, Basinghall Street, E.C.

Fowler-Waring Cables Company, Limited.—The annual return of this company, made up to the 1st ult., was filed on the 6th ult. The nominal capital is £200,000 divided into 39,700 ordinary and 300 founders shares of £5 each. 20,000 ordinary and the founders' shares have been taken up, the founders' shares having been issued as fully paid. Upon the ordinary shares £4 10s. per share has been called, and £89,850 has been paid, leaving £150 unpaid. Registered office, Victoria Mansions, 32, Victoria Street, Westminster, S.W.

Phonophore Syndicate, Limited.—The annual return of this company, made up to the 5th ult., was filed on the 12th ult. The nominal capital is £100,000, divided into 70,000 ordinary and 30,000 deferred shares of £1 each. 90,000 shares have been taken up, of which 39,025 ordinary and 30,000 deferred shares were issued as fully paid. Upon the remaining 20,975 the full amount has been called and paid, and £676 has been paid on 676 shares forfeited. Registered office, Blomfield House, London Wall, E.C.

Electric Construction Corporation, Limited.—The annual return of this company, made up to the 5th ult., was filed on the 12th ult. The nominal capital is £500,000 divided into 49,000 ordinary and 300 founders' shares of £10 each. All the shares have been taken up, and 4,900 issued as fully paid. Upon the remaining shares the full amount has been called, and £442,790 has been paid, leaving £8,210 unpaid. Registered office, Worcester House, Walbrook, E.C.

LEGAL.

Laing, Wharton and Down v. Mason, also Sidney Sharp and Kent v. same.—On Friday last, Frederick William Mason, 22, describing himself as an electrician, of 11, Dunston Road, East Dulwich, was charged on a warrant, at Clerkenwell, before Mr. Bros, with obtaining by fraudulent pretence four electrical testing instruments, value £20 3s., from Messrs. Laing, Wharton and Down, electrical instrument manufacturers, on the 1st of June last. The prisoner was further charged with obtaining two electrical instruments, value £10 8s. 3d., by fraud from Sidney Sharp and Kent, electricians, of Victoria Street, Westminster, on May 26th, 1891. Paul Rands, manager to Messrs. Sharp and Kent, said that on the 1st of May he received an order purporting to come from the "Aluminium Electric Company," asking for an electric instrument to be made and sent to 11, Great Sutton Street, Clerkenwell. This was done, and on the 26th of May another instrument was made and sent to the same address, a bill being forwarded for £10 8s. 3d. The witness had visited 11, Great Sutton Street, and believed no electrical business was carried on there. The account had not been settled. The landlord of the premises said the prisoner occupied a workshop and office there from May to September. Detective-Sergeant Sewell proved the arrest of Mason at an office at 29, Lloyd's Row, Clerkenwell, where a number of books, papers and circulars were seized. Some of the circulars were headed "Marson Battery Company," and "Clinton Electric Company." The detective said several charges would be brought against the prisoner. Mason was remanded.

Peat v. Brush Electrical Engineering Company.—Mr. Justice Kekewich, sitting in the Chancery Division of the High Court of Justice, heard on Tuesday week a summons taken out by the representatives of the late Mr. Peat, as owner of 2,000 shares in the Australasian Electric Light and Power Company, asking that they should not be compelled to accept, in lieu of these shares, issues in the Brush Electrical Engineering Company, to which the assets of the Australasian Company had been assigned; but might, instead, under the 161st section of the Companies' Acts, be declared entitled to have their share of the assets valued. Mr. Justice Kekewich held that the Australasian undertaking, assuming the forms to have been legally complied with, acted within their powers in making the transfer, even though the applicants refused to take part in the proceedings, and dismissed the summons with costs.

BUSINESS NOTICES, &c.

Catalogues.—We have received from Messrs. Paterson and Cooper copies of sections E and F of their catalogue, containing prices and illustrations of electric globes, shades, reflectors, &c., and silk and paper shades for use with the electric light. Messrs. Paterson and Cooper have spared no pains to make their catalogue as complete as possible.

We have received from Messrs. J. Sunderland & Co., of Halifax, an illustrated catalogue and price list of their electric light machinery and appliances. We have also received from Messrs. Woodhouse and Rawson price sheets of telephones and transmitters for domestic and long distance telephony. We have pleasure in drawing our readers' attention to both of these lists.

The Electric Light in the City.—There would appear to be an increase in the number of electric lighting installations in the City. A walk down Queen Victoria Street shows that at the moment no less than four installations are being carried out. Messrs. Arthur B. Gill & Co., of Parliament Street, are carrying out an installation at the offices of the Trust-Secured Savings Investment Corporation, Limited. Messrs. Rashleigh Phipps and Dawson are fitting one up at No. 40 and 42, Queen Victoria Street. Messrs. Smeeton and Page, of 63, Queen Victoria Street, are fitting up the electric light

at the new offices, in Queen Victoria Street, of Messrs. Wylie and Lockhead, Limited, paper stainers, while Messrs. Sharp and Kent, of Victoria Street, Westminster, are fitting up an installation at 111, Queen Victoria Street.

Willesden Paper.—It has been found that the Willesden waterproof paper is in many cases better than any other material for insulating purposes. It is said to be a perfect non-absorbent, and many of the leading electrical manufacturers are reported to be using it in preference to mica, on account of its cost being so much less.

The Electric Light in Westminster.—Messrs. Warren, Smith & Co., electrical engineers, of College Street, Chelsea, are putting in an installation of the electric light at No. 1, Old Palace Yard, Poets' Corner, Westminster.

Woodhouse & Rawson United, Limited.—We have received from Messrs. Woodhouse & Rawson one of their new calendars. The latter is arranged with movable dates and headings, and is very handy.

Electric Lighting of Margam Abbey. — Referring to our note of last week regarding the lighting of Margam Abbey by electricity, we understand that this successful installation has been carried out by Messrs. Drake & Gorham.

Tenders Wanted, Manilla.—We understand that the Municipality of Manilla are inviting tenders for the electric lighting of the town.

CITY NOTES.

City and South London Railway.

THE half-yearly meeting of the City and South London Railway Company was held on Tuesday at Winchester House, Old Broad Street, E.C., Mr. C. G. Mott presiding.

The SECRETARY (Mr. W. F. Knight) having read the notice convening the meeting,

The CHAIRMAN said that, before he proceeded to move the adoption of the report, he was sure that he would be expressing the feelings of all present in saying how much sorrow and sympathy they had felt with the Prince and Princess of Wales in the loss of their son, the Duke of Clarence and Avondale. The whole country had expressed sympathy with the Royal Family, having felt the loss very keenly; but to the company it came home more especially, for a little more than a year ago His Royal Highness was present at the opening ceremony of the railway. The young Duke went there of his own accord, showing the great interest he took in the line, and the fact that he fully appreciated the great benefits which its success would confer upon those concerned. He was sure they all desired to express their deepest sympathy with the Royal Family in their sad bereavement. Adverting to the report, the chairman said the directors regretted to again meet the shareholders without being able to declare a dividend on the ordinary stock. During the first half of the present year they had had, in common with many other lines, an unsatisfactory traffic. Their line was specially affected during the holiday season by the absence of many of their regular travellers, but they had anticipated that this would be far more than made up for by the increased traffic they should have received from the cricket matches which were at that time being played almost daily on the Oval. Unfortunately, the weather was so extremely bad during that period that there was hardly a cricket match which was anything like a success, and the company got little or no additional traffic from that source. The result was that their average receipts for the first quarter of the year were only £704 a week. When the holiday season was over, and the people began to get more confidence in the line, the traffic began to increase—so much so, in fact, that in the second quarter of the year their average receipts rose to £802. Thinking that the want of increase in the first part of the half-year might be due to the fares being excessive at some period of the day, and that a reduction of those fares might bring increased income, they made certain reductions and variations. So far this step had proved successful, but in some cases they had found that they could increase the fares again without losing traffic, and they were taking advantage of every possible opportunity to carry out that policy. The reduction of the fares had affected them in the following way. The average fare per passenger in the first portion of the last half-year was 1·9d., while in the second half it was reduced to 1·7d., exclusive of the season tickets. The difference between ·9d. and ·7d. meant more than £2,000 loss to the company, but this had been more than made up by the increased number of passengers carried, and the whole period showed an increase of about £600 in the total receipts. When they began to raise the fares on November 1st last, they introduced a system of season tickets. The number of season tickets issued was steadily increasing, and he was glad to say that those which had just expired were nearly all being renewed, thus showing that the company had given satisfaction to the holders of those tickets. The great fault of the line was the want of traffic and of sufficient receipts. Their receipts per train mile were 2s. 1½d., while the average receipts of the steam railways of England were about 5s. per train mile. Their expenses per train mile had been only 1s. 7¾d., whereas the expenses of an ordinary steam railway were 2s. 9d. But, of course, their trains did not carry as large a number of passengers as those on an ordinary steam railway. Their total expenses appeared to be very high, but he would remind them that they always were high in the early stages of a new railway. They amounted to 76 per cent. of the receipts for the half-year, but they must remember that, in addition to the ordinary traffic of a steam railway, this company had to provide the lifts which carried the passengers up and down at the stations, and which were quite extraneous to an ordinary railway on the surface. If they deducted the cost of working these lifts they would find that their expenses in the last half-year were reduced to 66½ per cent. of the earnings during that period, giving a very fair comparison with other railways. Now, if they had had £30,000 in receipts in the half-year instead of £20,000 they could have carried that traffic at little or no increase of expenses, and their working expenses would then have been reduced from 66½ per cent. to 45 per cent., which was lower than almost any steam railway in the kingdom. In the early stages of a railway the expenses were always higher than they were afterwards, when the traffic developed. For instance, the expenses of the London, Brighton and South Coast Company were 85 per cent. of their receipts in 1867, whereas last half-year they were 48 3/5 per cent. The expenses of the London, Chatham and Dover Company, too, were 71 per cent. of their receipts in 1866, so that the position of this company compared very favourably with that of other companies in their initial stages. Their expenses during the half-year had shown certain decreases, but these unfortunately had been counterbalanced by increases. The question of compensation had come in, and one or two small claims to the extent of about £92 had been settled. Then there was an increase in the rates and taxes of £152. On the other hand, the locomotive expenses were decreased by £388, the traffic expenses by £38, and the maintenance of the line by £104. There was likewise a small increase in the general charges, but the total result, as compared with the previous half-year, showed a trifling decrease. They had now had a year's experience of the working of electricity, and perhaps they looked to him to give them some facts and comparisons in regard to it which they were not able to give before. Of course they could not say for one moment that the present condition of working was by any means perfect. They were improving it every day, and he hoped they were going to lessen its cost. But he would give them a few of the results which they had learned so far during their experience of the past year. Their locomotive expenses were 7·88d. per train mile, while those of the main lines of the country, such as the North-Western, the Great Western, Midland and Great Northern averaged something over 9d. for the past half-year. This 7·88d. included the price paid for coal, and covered all the carriage expenses, but the 9d. only included the price paid at the pit's mouth. If they were in the position of other companies in this respect, their locomotive expenses per train mile, in consequence of the cost of carriage of the coal not being included, would be reduced to about 6¼d. In the companies where the carriage on the coal used had to be paid out of the locomotive expenses, the average was over 10d. As the directors said in the report, after the experience of the past year, there was every reason to be satisfied with the use of electricity as a motive power for the working of this railway, and for a confident belief that when all the details are fully perfected, it will be found to be at once safe, convenient and economical. Its safety they had proved, because they had had no accidents. Its convenience was proved, and would be more than proved in the future. As to its economy, he had told them their expenses were 1s. 7¾d. per train mile, against 2s. 9d., the average of steam companies. The retort to this was that their trains were very much smaller and lighter. This was true, but it must be remembered that the average number of people per train they had carried during the last half-year was 47, while the average in the ordinary steam train all over the country was 45, the rest which they carried being deadweight, which was not paying them anything. The Board held that instead of running trains only partially filled, it was better to run smaller and lighter trains, which held a far greater proportion of passengers to their weight, and that the number of these light trains had better be increased than to have fewer trains of very much heavier weight; it was more to public convenience, and would be found in the end more economical. It was generally reckoned in an ordinary steam train that a ton weight of carriages would provide for three persons. In their own case a ton weight accommodated five persons, showing that in their electrical arrangements they had a decided advantage in point of weight over the steam railway. The chairman then went on to reply to the statement made by Sir Edward Watkin at the Metropolitan Railway meeting, to the effect that an electric engine could only draw a train equal to its own weight, and declared that their own experience was that one of their engines would take three times its weight behind it, even up an incline. Having stated that their trains were running at the rate of 13 miles an hour at the present time, including stoppages, a result which was considerably above the metropolitan trains, the chairman said that the facts which they had learned during the past year pointed, at no very distant date, to the substitution of electricity over steam very largely over the railways of the world. After touching upon the prospectuses issued in the first instance, and speaking of the impossibility of working the railway on the cable system, Mr. Mott went on to allude to the excellent construction of the company's line, and afterwards to the heavy traffic which had to be provided for at the King William Street station. He then directed attention to the failure of railway companies generally to adequately cope with heavy traffic at the terminal stations in the City, and said the board intended to profit by the experience of these companies. They proposed to seek powers to enable them to take a line through the City without having a terminal station in the City. They thought it would be the best policy to have a terminus where they could get the necessary land at a small cost, to give them the sidings which would be required to work the line efficiently. They had already motive power far in excess of their immediate wants, and could work a much longer length of line with their present power. All this pointed to the wisdom and desirability of the plans, which had been deposited with the Govern-

ment, being passed. They had arranged with the Brighton Company for a station at the bottom of Denman Street in connection with their line, and this would throw an enormous amount of traffic upon the electric railway. The board anticipated a difficulty in raising capital for the proposed new works, and they had therefore taken power to carry out such portions as might be deemed necessary with an independent capital, so as not to throw the burden upon this company; and although they would benefit very considerably under such arrangements, the risks would be almost nil. The question, however, as to by whom the money should be provided, would not have to be determined until after they had obtained the Bill. He would have postponed the application to Parliament had he been able to do so; but owing to circumstances which he could not go into publicly, he was bound to adopt the course which he had pursued. It was certainly essential to the interests of the company that the Bill should go on, and the directors appealed to the shareholders for their confidence and support in the matter. He, personally, was ready to let his position as chairman rest upon the decision of the shareholders in this matter. In conclusion, he begged to move the reception and adoption of the report and statement of accounts as submitted.

Mr. S. HANBURY seconded the motion.

Mr. TURNBULL made enquiries as to the hitches which had occurred in the working of the railway.

Mr. MIDDLETON said he was in favour of the expenses being cut down more than they had been in the past. The directors had far better turn their attention in that direction than consider any extension scheme.

Mr. VAN LAUN asked whether there was any truth in the statement which was constantly being made that electricity as a motive power had failed on the line?

The CHAIRMAN said that instead of being a failure electricity was a most decided success. Stoppages did, of course, unfortunately occur, but they were caused by the strain which was put upon the motors on the engines in ascending the incline into the King William Street station with very heavy loads. When the new armatures were completed these breakdowns would occur very rarely indeed.

The resolution, upon being put, was carried unanimously.

The CHAIRMAN next moved that a dividend on the preference capital at the rate of 5 per cent. per annum be declared in respect of the past half-year.

Mr. MIDDLETON seconded the motion, which was agreed to.

On the motion of Mr. C. S. GRENFELL, seconded by Mr. E. TATE, Mr. Mott was re-appointed a director, and after the CHAIRMAN had acknowledged this expression of the confidence of the shareholders, the auditors, Messrs. Turquand, Youngs & Co., and Mr. George Kitson, were re-elected.

A special general meeting was then held, for the purpose of submitting a Bill now pending in Parliament, entitled, "A Bill to empower the City and South London Railway Company to make an underground railway to Islington, and for other purposes," to the shareholders for their approval or otherwise.

The SOLICITOR having explained the Bill, its approval was moved by the CHAIRMAN, who briefly informed the meeting as to the route proposed to be taken through the City.

Mr. HANBURY seconded the motion, which, having been opposed by Mr. MIDDLETON, was put to the meeting, and carried by 26 votes to 5.

Mr. MIDDLETON demanded a poll, and the CHAIRMAN said it would be taken on Tuesday, the 9th inst., at the offices of the company from twelve until two o clock.

The proceedings concluded with votes of thanks to the chairman, the directors, and the staff.

Anglo-American Telegraph Company, Limited.

THE ordinary general half-yearly meeting of this company was held on Friday last at Winchester House, Old Broad Street, E.C., Mr. Francis A. Bevan (Deputy Chairman) presiding in the absence of the Chairman, the Marquis of Tweeddale.

The SECRETARY having read the notice convening the meeting, also the minutes of the previous meeting,

The CHAIRMAN said that it was his duty, in addressing the shareholders, to express his regret that their chairman was unfortunately prevented from taking the chair as usual, owing to illness. His Lordship himself thought that he was better, but his doctor said that it would not be wise for him to be at the meeting. They had also to regret that Mr. Cyrus Field, their old and valued friend, was unable to be there, for reasons of which they had already heard. He thought, in regretting Mr. Field's absence, he was expressing the feelings of the meeting. They could never forget that it was mainly owing to his skill and pertinacity that Atlantic telegraphy was ever successful, and in spite of repeated failures Mr. Field was able to see the idea he had so much at heart, carried to triumphant result. The chairman said that he could understand that on reading the report there might have been a certain amount of disappointment at the result of the year's working. On looking into the accounts they found that there was almost no increase in the receipts, but he might explain that of the increase of £6,000, there were certain amounts of about £4,000 which were really matters of account, and that the real increase in the receipts of the half-year were only £1,500 beyond this £4,000 to which he referred, and he did not think that they could be greatly surprised at that when they took the state of business into account. He had seen the figures of the Clearing House returns for the last year, but he did not think he was at liberty exactly to mention them before they were published. When they were published they would see that there had been a falling off in business during the past year of many hundreds of millions as far as the returns of the Clearing House [illegible] (not referred to the bankers' clearing house), which was perhaps as good an indication as they could possibly have that there had been much less business transacted during the past year than during the previous one, and they knew to what that was principally attributable. They could hardly expect that in that state of business they would be able even to maintain the amount of receipts of the previous year, but he was glad to say that they had not only maintained that amount, but that their receipts were even a little larger than they were during the corresponding half-year. On the other hand, there had been an increase of expenses, and that was owing principally to two causes—first of all they had spent more upon the development of their business, they had had to open new stations in order to meet the competition, which was very powerful, and they knew that in these days that unless people had telegraph stations brought almost to their very doors, they question whether they will telegraph at all. This company had therefore had to spend some thousands of pounds in establishing new stations, a policy of which the chairman felt sure they would all approve. Besides that, they had had to spend rather more than usual upon the repairs of cables. As they would see in paragraph 4 of the report, the company's repairing steamship *Minia* had been engaged during the past half-year in the repair of the 1880 cable, the Brest-St.-Pierre cable, the North and South Placentia cables, and the Duxbury cable; whereas in the previous half-year they had very few repairs, so that they had had not only to open these new stations for the development of their business, but had also had to spend more than usual upon their repairs. The result was that the amount available for dividend, he regretted to say, was rather less than it was for the previous half-year; but he would just throw a little ray of light upon what appeared to be rather a dark statement; he was glad to say that the new year had opened better, and they were able to report that from the 1st to the 28th of this month there had been a daily increase of £50 in the receipts, and if business would only become better, no doubt they would share in the good results which would ensue. Whilst referring to the company's cables, he stated that they would see that the *Minia* had been employed in laying a cable from North Sydney, Cape Breton, to Canso, which meant 116 miles of new cable laid down to make a most important connection. This brought them into more direct communication with New York than before; it completed the through cable communication between England and New York City, and they had not, as some might have supposed, taken this out of ordinary revenue, but they proposed, with the shareholders' sanction, to take this from the renewal fund, as they were aware they had no capital funds to which they could debit such an amount, and therefore they thought it fair and legitimate, but they must ask the shareholders' concurrence to debit that £12,000 to the renewal fund. It appeared to the directors that no more legitimate use could be made of the renewal fund than such an expenditure as that, and they therefore believed that the shareholders would be very glad to sanction such an expenditure. It had been suggested to the directors that they should increase the dividend by taking something from the renewal fund. He was convinced that that would be a very unwise thing to do. The renewal fund was the very backbone of the company, and if it had not been that they had this large fund at their back when they had that competition with their rivals, he did not know where they would have been. In the event of any serious breakdown to any of their cables, the only source from which they could repair it was from this renewal fund. At this very moment their Brest cable was broken in deep water, something over a thousand fathoms. They were endeavouring to repair it, but hitherto without success. Suppose one of their cables broke and they could not repair it, but had to lay a new cable, where, he asked, except for this renewal fund, could they get the money with which to do it? He therefore hoped that no one would ask them to pay dividends which they had not earned, and which would give a false impression on the money market, and probably cause the shares to fall. As to the future, all that the directors could do was to maintain the cables in a state of efficiency, and, as far as possible, to organise their work proper. They had been directing their attention to getting their messages as correctly as possible. They could not make people send messages, but he thought the shareholders might assist them by inducing their friends to patronise them, and in that way they might get as many messages by fair and legitimate means.

Sir JAMES ANDERSON seconded the motion.

A long discussion followed, in the course of which dissatisfaction was expressed with the dividend.

Several shareholders suggested that the dividend should be assisted by drawing from the renewal fund, but the majority of shareholders were entirely opposed to this course.

A SHAREHOLDER reminded the meeting that on one occasion a director, who presided in the place of the chairman, stated that when the renewal fund reached £1,000,000, the interest earned by the investment forming the fund was to go to the payment of dividends.

The CHAIRMAN, in reply, said he could only repeat what he had already stated, that in the opinion of the directors it would be most unwise to draw upon the renewal account. The renewal fund amounted to something like a million, and it was quite an open question whether, when the fund had fairly reached a million, they should not give the shareholders the benefit of the interest. He merely said it was a question, but he did not pledge himself that that course would be pursued.

The report and accounts were then unanimously passed, and final dividends of 16s. per cent. on the ordinary stock, and £1 12s. per cent., on the preferred stock, making a total distribution for the year ended December 31st last of £2 12s. 6d. per cent. on the ordinary stock, and £5 5s. per cent. on the preferred stock were declared.

The directors retiring in accordance with the articles of association, Mr. F. A. Bevan and Mr. Charles Burt were then re-elected. The auditors, Mr. Joshua Dean and Mr. John Gane, F.C.A., were likewise re-elected, and a vote of thanks to the chairman and directors closed the proceedings.

Newcastle-upon-Tyne Electric Supply Company, Limited.

BALANCE SHEET, 31st December, 1891.

LIABILITIES.

DR.	£	s.	d.
Nominal capital, 10,000 shares of £5 each	50,000	0	0
Present issue, 5,000 shares of £5 each...	25,000	0	0
Issued and allotted, 4,066 shares of £4 per share called up £16,264, and 802 shares of £3 per share called up £2,406	18,670	0	0
Add calls paid in advance £1,332, less calls due January 8th, 1892, £550, also calls in arrear £100	682	0	0
... ...	19,352	0	0
Six per cent. mortgage debentures	15,000	0	0
Creditors on sundry accounts	5,281	11	5
Profit for year to date	1,006	8	7
	£40,640	0	0

ASSETS.

CR.	£	s.	d.
Capital expenditure to date, buildings and plant, £29,427 5s. 2d., meters; transformers, &c., £4,159 17s. 1d....	33,587	2	3
Loose plants and tools	294	19	6
Office furniture	104	15	8
Preliminary and formation expenses	654	3	8
Stocks and work in progress	1,887	17	1
Debtors, on current supply £1,106 17s. 5d., and sundry debtors £1,128 19s. 5d.	2,235	16	10
Cash at banker's on deposit with interest £1,520 18s. 8d.; current account £275 15s. 8d.; in hand £78 10s. 8d.	1,875	5	0
	£40,640	0	0

THE PROFIT AND LOSS ACCOUNT for the year ending December 31st, 1891.

DR.	£	s.	d.
To Station charges—Salaries, wages, coal, water, and maintenance	1,982	10	6
„ Street charges—Salaries and maintenance	333	13	2
„ Rent, rates, taxes and insurance	307	11	11
„ General charges—Office salaries, legal and accountancy charges, stationery, stamps, telegrams, &c.	385	16	1
„ Balance carried down	1,668	3	0
	£4,677	14	8

CR.	£	s.	d.
By Current supply, £4,300 13s. 7d.; to public lamp supply, £27 6s. 7d.	4,328	0	2
„ Apparatus rent	345	11	7
„ Profit on sale of lamps	4	2	11
	£4,677	14	8

DR.	£	s.	d.
To Interest on debentures £610 13s. 9d.; and on calls paid in advance £51 0s. 8d.	661	14	5
„ Balance carried down	1,006	8	7
	£1,668	3	0

CR.	£	s.	d.
By Balance brought down, being gross profit for year	1,668	3	0
By Balance brought down, being net profit for year ...	1,006	8	7

Audited and certified, as per report,
(Signed) JOHN H. ARMSTRONG,
Chartered Accountant.

Newcastle-on-Tyne,
January 20th, 1892.

Central London Railway Company.

THE first ordinary (statutory) general meeting of the Central London Railway Company was held yesterday, at the offices, 30 and 31, St. Swithin's Lane, E.C., Mr. F. A. Lucas, presiding.

The CHAIRMAN made no remarks, but simply proposed that Messrs. De Crano, Lucas, Mosenthal, and Parrish, who retired in accordance with the provisions of the Central London Railway Act, be re-elected.

Mr. OPPENHEIM seconded the motion, which was carried unanimously.

The meeting was then made extraordinary, for the purpose of considering the Bill for 1892.

Mr. MORRIS (the solicitor) explained that by the Act of 1891, the Central London Railway Company, which was by that Act incorporated, was authorised to make a railway, six miles in length, from Shepherd's Bush to Cornhill. By the Bill before the meeting, it was proposed to abandon so much of the authorised railway as was in Cornhill, and instead of making, as proposed, a railway to the terminal station in Cornhill, to continue it up Threadneedle Street and Broad Street to the Liverpool Street Station of the Great Eastern Railway, where the Central London Railway would connect by subways with the Great Eastern and North London Railways.

The CHAIRMAN moved that the Bill be approved, subject to such alterations as Parliament may think fit to make, and the motion having been seconded by Mr. MOSENTHAL, it was carried unanimously.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

THE directors announce that the accounts of this company, subject to audit, to December 31st, 1891, show the following results:—

Brought forward from 1890	£39,970
Net profit for 1891	79,100
	119,070
Less interim dividend paid in July, 1891, 5 per cent.	20,800
	£98,270

The directors have resolved to add £25,000 to the reserve fund, and to recommend a further dividend of 5 per cent. (making 10 per cent. for 1891), and a bonus of 2½ per cent., carrying forward £42,070.

Notice of the annual meeting will be issued with the director's report and accounts, after audit, as usual.

Liverpool Overhead Railway Company.

THE directors, in their report, state that the main structure of the Overhead Railway has been advanced to St. Nicholas's Place, where the bowstring spans, intended to carry the line across this space, are in the course of erection. The foundations for the southern section are nearly completed, and many of the columns and cross girders are in place, and as soon as St. Nicholas's Place is crossed, rapid progress will be made with this portion of the work. Arrangements have been made with the Dock Board to lease a site for the electric generating station at the Wellington Dock; the position immediately under the coal railway and adjoining the dock affords very exceptional facilities for the economical production of electrical power. The electrical equipment and rolling stock are well advanced towards completion. The balance brought forward from last half-year to the credit of revenue account was £1,447, to which must be added interest allowed by the company's bankers, &c., £126, making a total of £1,574. After deducting £198 for interest on amount paid in advance of calls, and cost of administration, £462, there remains a credit balance of £913.

The Edison and Swan United Electric Light Company, Limited.—At a board meeting on February 2nd, 1892, it was resolved that a payment on account of the dividend of the current year be made. On the 89,261 shares, £3 paid, of 5s. 3d. per share; on the 5,000 fully paid shares, allotted to the Edison Company, 8s. 9d. per share; on the 12,139 fully paid shares, allotted to the Swan United Company, 7s. 8d. per share. The payment will be made upon the register as it stands this day, and the dividend warrants will be issued on the 22nd instant.

The Eastern and South African Telegraph Company, Limited.—The Eastern and South African Telegraph Company, Limited, announce the payments by warrants, on February 1st next, of interest for the half-year ending January 31st on their 4 per cent. mortgage debentures. The transfer books will be closed from January 29th to February 1st, both days inclusive.

The Eastern Telegraph Company, Limited.—The Eastern Telegraph Company, Limited, notify that the coupons on their 5 per cent. debentures, due February 1st next, will be paid on and after that date at the banking house of Messrs. Glyn, Mills, Currie & Co., 67, Lombard Street, E.C. Coupons should be left at the bank three clear days for examination.

St. James's and Pall Mall Electric Light Company, Limited.—As arranged at the meeting of this company last week, a poll was taken on Tuesday last as to whether Mr. Egerton Clarke should be re-elected or not, the result being that Mr. Clarke has been re-elected as a director of the company.

Elmore's American and Canadian Copper Depositing Company, Limited.—Letters of allotment of this company were posted Tuesday evening. We are informed that the applications have been very numerous, and that allotments have been made to nearly 700 persons.

The Cuba Submarine Telegraph Company, Limited.—This company, after providing for the dividend on the preference shares, recommend a dividend on the ordinary shares at the rate of 8 per cent. per annum, tax free.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The receipts for the month of January were £3,500 as compared with £2,489 in the corresponding month of last year.

Direct Spanish Telegraph Company, Limited. The estimated traffic receipts for the month of January, 1892, are £2,195, as against £2,147 in the corresponding period of last year.

The West India and Panama Telegraph Company. The receipts of the West India and Panama Telegraph Company for the two weeks ended January 31st, show a decrease of £1,056 as compared with the corresponding period.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (Jan. 28th.)	Closing Quotation. (Feb. 4th.)	Business done during week ending (Feb. 4th, 1892.) Highest.	Lowest.
250,000*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	99 —102	99 — 102	...	...
1,300,980*l*	Anglo-American Telegraph, Limited	Stock	51 — 52	50 — 51	51⅛	50½
2,849,510*l*	Do. do. 6 p.c. Preferred	Stock	89½ — 90½	89 — 90	90½	89
2,849,510*l*	Do. do. Deferred	Stock	13 — 13½	12½ — 13	13 1/16	12⅞
130,000*l*	Brazilian Submarine Telegraph, Limited	10	10¼ — 10⅜	10½ — 11	10⅝	10½
53,200*l*	Do. do. 5 p.c. Bonds	100	102 —105	100 —103xd	...	...
75,000*l*	Do. do. 5 p.c., 2nd Series, repayable in June, 1906 ...	100	103 —107	103 —107	...	...
77,978*l*	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3½ — 3¾	3½ — 3¾xd	3 7/16	3¼
69,996*l*	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜	2 — 2⅛xd	2⅛	2
40,000*l*	Chili Telephone, Limited, Nos. 1 to 40,000	5	3½ — 4¼	3½ — 4¼	...	...
50,000*l*	City and South London Railway, Nos. 1 to 50,000	10	2½ — 3½	2½ — 3½	...	...
30,152*l*	City of London Elec. Lighting Co., Ltd., Ord. 40,001-70,152, £4 paid	10	6 — 6¼	6 — 6¼	6⅜	6⅛
$7,716,000	Commercial Cable, Capital Stock	$100	153 —157	153 —157	...	...
224,850*l*	Consolidated Telephone Construction and Maintenance, Limited ...	14/-	⅜ — ½	⅜ — ½	...	...
20,000*l*	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5½ — 6	5⅝ — 6	5⅝	...
16,000*l*	Cuba Telegraph, Limited	10	10 — 11	10 — 11	10 11/16	...
6,000*l*	Do. do. 10 p. c. Preference	10	16½ — 17½	16½ — 17½	...	...
12,931*l*	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	3½ — 3⅝	3½ — 3⅝	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	8½ — 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11 — 11¼	11 — 11¼	11¼	11 1/16
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅜ — 14⅝	14⅜ — 14⅝	14⅝	14⅜
70,000	Do. 6 p. c. Preference	10	15 — 15½	15 — 15½	15½	15 5/16
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 —111	105 —108 xd	106	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	106 —109	107 — 110	109½	108
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅛ — 15⅜	15 — 15¼	15 5/16	15
78,300*l*	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	102 —105	...	...
276,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	107 —110	105 —108	109	106¼
135,000*l*	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104	...	...
180,400*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	101 —104	101 —104	...	...
201,600*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	99 —102	98 —101 xd	101½	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	6 — 6¼	6 — 6½	6 5/16	6
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
66,750	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	2⅛ — 2⅜	2⅛ — 2⅜	2⅜	2 1/16
70,000	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	3⅜ — 3⅝	3⅛ — 3⅜	3 11/16	2 15/16
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	2⅛ — 2⅜	2 — 2⅛	2	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	2 — 3	2 — 3	...	...
180,227	Globe Telegraph and Trust, Limited	10	10 — 10¼	9⅞ — 10¼xd	10⅛	9⅞
180,042	Do. do. 6 p. c. Preference	10	14⅞ — 15⅛	14½ — 15 xd	15	14⅜
150,000	Great Northern Tel. Company of Copenhagen	10	19 — 19½	19 — 19½	...	...
220,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	105 —108	106 —109	...	...
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	8 — 8½	7¾ — 8½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	9½ — 10½	9½ — 10½	...	...
41,600	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½ — 22	22 — 23	23	21⅝
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	103 —105	103 —105	104⅜	...
17,000	Indo-European Telegraph, Limited	25	41 — 43	41 — 43	42⅜	41
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	3⅓ — 4½	3½ — 4½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	8 — 9	8 — 9	...	...
30,000	†Liverpool Electric Supply, £3 paid	5	2⅝ — 2⅞	2⅝ — 2⅞	2⅞	2⅝
10,000	Do. do. fully paid	5	4⅞ — 5	4⅝ — 5	4⅝	...
38,348	London Platino-Brazilian Telegraph, Limited	10	6 — 7	6 — 7	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	8½ — 8⅝	9 — 9½	9½	9
447,234*l*	National Telephone, Limited, Nos. 1. to 438,934	5	4 — 4¼	4⅛ — 4⅜	4⅛	4 3/16
15,000	Do. 6 p. c. Cum., 1st Preference	10	12½ — 13	12⅝ — 13⅛	13⅛	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	12 — 12½	11½ — 12⅛	...	...
420,000*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	104 —107	104 —107	105⅜	105⅛
250,000*l*	Do. (issued at 5 p.m., all paid)	...	54 — 57	54 — 57	...	...
6,318*l*	Notting Hill Electric Lighting Company, Limited, £8 paid ...	10	5½ — 6⅛	5 — 6	...	...
220,000*l*	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	3/16 — 5/16	3/16 — 5/16	...	...
9,000*l*	Reuter's Limited	8	7½ — 8	7½ — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8½ — 9	8½ — 9xd	9	8 9/16
7,900	Do. do. do. 7 per cent. pref.	5	7½ — 7¾	7½ — 7¾xd	7 9/16	7 7/16
3,381	Submarine Cables Trust	Cert.	116 —121	116 —121	...	...
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3½ — 4	3½ — 4	4	3⅜
37,350	Telegraph Construction and Maintenance, Limited	12	42 — 44	42 — 44	43⅞	43½
150,000*l*	Do. do. do. 5 p. c. Bonds, red. 1891	100	100 —103	100 —103	...	...
58,000	United River Plate Telephone, Limited	5	1 — 2	1 — 2	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	80 — 90	80 — 90	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	7 — 8	7 — 8	...	...
271,400*l*	Do. do. do. 5 p. c. Debentures	100	101 —104	101 —104	...	...
30,000	West Coast of America Telegraph, Limited	10	4 — 5	4 — 5	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	99 — 103	101 —105	104½	104
67,007*l*	Western and Brazilian Telegraph, Limited	15	10 — 10½	10 — 10½	10⅜	10⅛
30,364*l*	Do. do. do. 5 p. c. Cum. Preferred	7½	6½ — 6¾	6½ — 6¾	6¾	6 7/8
30,364*l*	Do. do. do. 5 p. c. Deferred	7½	3⅞ — 4¼	3⅞ — 4¼	4⅛	...
189,700*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	104 —107	101 —104xd	...	...
237,200*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	104 —107	101 —104xd	...	...
88,321	West India and Panama Telegraph, Limited	10	1⅝ — 1⅞	1⅝ — 1⅞	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9¼ — 9¾	9¼ — 10	9 13/16	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	8 — 9	8½ — 9½	9	8 1/16
$1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	118 —122	118 —122	...	...
173,100*l*	Do. do. 6 p. c. Sterling Bonds	100	98 —102	98 —102	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	6⅞ — 7⅛	6½ — 7	7	6⅞

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid) 7½—7⅞.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Halifax and Bermuda Cable, 4½ per cent. bonds 85—95.—House to House Company (£5 paid) 4½—5.—7 per cent. Preference Shares of £5 (fully paid) 5¾—6.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5½—6, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6½—6.—Liverpool Electric Supply Shares of £5 (fully paid), 4⅞—5.—Do. shares of £5 (£3 paid), 2⅝—2¾.—London Electric Supply Corporation, Ordinary (£5 paid), 1—1⅛.—Do. 6 per cent. Preference, 1½—2.—Manchester, Edison and Swan Company, £9 (£1 paid), ½—⅝.—Queen Anne's Mansions Lighting and Heating, Deferred shares of £10 (fully paid), 10—9.—Do. 6½ per cent. preference shares of £10 (fully paid), 10—9.—Do. Debentures, 103—½.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), 1⅛—1¼.—£5 Preference (fully paid) 3½—3¾.—Ward's Electric Car (£10 paid), 1⅛—1⅜.

† Quotations on Liverpool Stock Exchange.

BANK RATE OF DISCOUNT.—3 per cent. (January 21st, 1892).

NOTES ON THE DISTRIBUTION OF POWER BY ALTERNATING CURRENTS.*

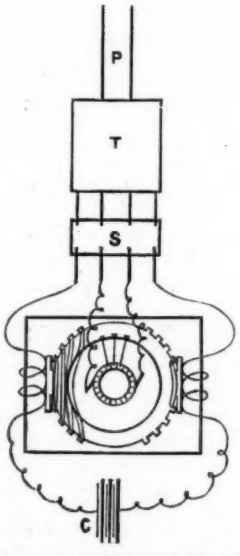
BY MR. W. B. TOBEY, of the Stanley Laboratory.

FOR a number of years the electrical public have been looking forward to the production of a commercial alternating current motor. Up to this time the demand is unsatisfied, and a motor of this type is a thing unknown to the practical engineer. It is true that alternate currents have been utilised in a few instances to actuate synchronous and multiphase motors, but the difficulties arising in these problems have thus far prevented their general adoption. We are aware that the practical engineer has become sceptical of the realisation of the alternating current motor, and that all statements to the contrary notwithstanding, he is apt to take inventor's certificates of their work *cum grano salis*. For this reason, in describing to you some of our work on alternating current motors, we shall simply invite your criticisms of the methods employed, their practical value, and their usefulness to the engineer, and shall leave your minds free to accept or reject it on this evidence. The motor will soon be placed on the market, and may then be judged by its practical operation.

It has appeared necessary to us that any system of power distribution by alternating currents of electricity to be commercial should be operated on the existing systems of current supply, viz., the multiple transformer system of standard frequency.

In order to produce a motor to fit these conditions, we have studied an ordinary continuous current motor when supplied with alternating currents, for it is evident that if the electrical reactions produced by alternating currents in a motor are similar to those produced by continuous currents, the problem would be a comparatively simple one. In pursuing this problem many difficulties have arisen requiring special investigation and treatment; so that while the finished motor operates as well on alternate as on continuous currents, the steps by which these results were attained have been both difficult and laborious.

The motor now to be described is the invention of Mr. Wm. Stanley, jun., and Mr. John F. Kelly, and is the outgrowth of a motor described by them in the electrical papers some time since, in which a condenser is used in the field



P, Primary wires; T, Transformers; S, Four-break switch; C, Condenser in field circuit.

CONNECTIONS OF STANLEY-KELLY MOTOR.

circuit. The present form makes use of the condenser, and embodies several improvements, the most important of which is the compensating winding.

In general, the motor is of the two or four-pole type (although the number of poles is not restricted), having a well laminated field and armature. The field coils are of comparatively few turns, which may be placed on the poles as in the ordinary type of direct current motor, and are connected either in series or multiple through a condenser to a source of alternating current. The armature is of a specially wound closed circuit type, having an ordinary Gramme commutator on which bear two brushes placed on the neutral line or lines. These brushes are connected to the source of alternating current supply. The transformer furnishing current to the shunt type of motor has two secondaries, one of which supplies the field with a constant current, while the other supplies a variable current to the armature.

Before taking up the description of the motor in detail, let us see the effect of applying an alternating E.M.F. to a continuous current shunt wound motor.

We will consider a motor wound with 3,000 turns on its field, which when in circuit furnishes the necessary magnetising power of 500,000 C.G.S. lines of magnetism through the armature. Just as in a transformer, the reactive effect of the magnetism on the primary coil develops a counter E.M.F. of self-induction, so also the effect of the field magnetism on the field coils develops a counter E.M.F. which practically annihilates the impressed E.M.F., and by preventing nearly all the current from flowing through the field circuit greatly reduces the magnetism.

It is, of course, possible to apply a sufficiently high E.M.F. to give the required field magnetisation, but a brief calculation shows that under the conditions assumed this E.M.F. would be about 9,000 volts, a pressure entirely out of the question. The magnetisation set up through a given circuit is approximately proportional to the product of the number of turns and the current, viz: the ampère turns, which product may of course be obtained with a fewer number of turns and a larger current. This has an important bearing in reducing the applied E.M.F. on the field. Instead of 3,000 turns, suppose we take 250; to give the same magnetisation, the current will have to be twelve times as great, and calculation shows the necessary E.M.F. to be about 750 volts. Fortunately, it is not necessary to employ this as an impressed E.M.F. from the transformer, for by inserting into the field circuit a condenser of proper size (dependent on the number of alternations, the reluctance of the circuit, the turns, &c.), there is developed an E.M.F. between the condenser terminals that always opposes the E.M.F. of self-induction in time and value, and destroys all effects of self-induction, allowing the same amount of current to flow as if the circuit were supplied with a continuous current, neglecting of course losses due to extra apparent resistance caused by hysteresis and Foucault currents. By inserting a condenser into the field circuit, any low E.M.F. as 100 volts may be used to magnetise the field, thus obviating the use of high potentials. The employment of the condenser has also the advantage of reducing the lag of the current behind the applied E.M.F., a result which would take place if a field E.M.F. of 750 volts were used, and no condenser was in circuit. Thus two of the difficulties of operating a motor by alternating currents are overcome, 1st, that of obtaining the required magnetisation to flux the field without employing a high E.M.F.; 2nd, that of causing this magnetisation to occur at the proper time, viz., in phase with the E.M.F. applied.

Imagine a motor magnetised as described, having an alternate current applied to its armature, there will be a lag of the current in the armature behind its E.M.F., as was the case of the field current. To give the maximum amount of power and torque for given values of currents in the field and armature, they must flow in unison; for if there be a lag between the field magnetisation and armature current during that part of an alternation in which the currents coincide, the pull will be in one direction, and during that part of the alternation in which the currents are opposed, the pull will be reversed. To overcome this difficulty, we have wound about the armature, parallel to the direction of the field magnetisation, a number of short-circuited coils sunk in slots in the field poles.

This short-circuited winding is only acted upon by the currents in the armature coils, and as a short circuit in the secondary coil of the transformer destroys the self-induction of the primary circuit, so the currents induced by the armature currents in the short-circuited coils reduce the self-induction and consequent lag in the armature current, and

* Paper read before the Chicago Electric Club, January 18th, 1892.

bring it in phase with the applied E.M.F. Clearly the E.M.Fs. applied to the field and armature coincide (because they come from the same transformer), and as there is no lag in either the field or armature current, it is evident that the field magnetisation and armature current must coincide, and that the torque of the motor must always be in one direction. Thus another difficulty is removed.

Aside from the difficulties mentioned, many others have arisen requiring much special attention. These have mostly been remedied by the careful designing and proportioning of the various parts, although the problem of getting a good, durable and cheap form of condenser has been a long study by itself.

If a motor, made as described, be supplied with alternating currents, it will start from rest with the same torque as if supplied with continuous current. If it is run free of load, the current in the armature will be small, and as the load on it is increased, the current in the armature will increase in like proportion. In short, it will behave exactly like a continuous current motor.

Supplied thus with a motor for alternating currents, meeting all the requirements demanded of a continuous current motor, we are required to show the advantages of the alternate system of motor supply.

It is not necessary to impress on you the advantages of the alternating current system of distribution over any other yet devised, and while this system as at present used has greatly advanced the distribution of electricity from central stations, it is nevertheless a fact that the greatest difficulty in distributing from large stations is the cost and maintenance of the working feeders. The cost of feeders for distributing current from large stations are often greater than the cost of the station equipment, and the feeders are even then inadequate to the demands made upon them.

For the moment it will be advisable to assume the responsibility of designing a station and system of distribution which shall furnish the required currents for the heart of a large city, and in assuming that a single station is to be equipped to deliver currents for 100,000 16-C.P. lamps, and for 10,000 horse-power of motor service, we are assuming conditions which will approximately fill the requirements of many large stations that are now entirely unable to meet the demands made upon them.

Assuming conditions of this magnitude, we are to find out if they can be met by apparatus now devised by the engineering profession. There are at present in this country several builders of engines who can furnish triple expansion engines of 1,000 H.P. each. With each of these engines 10,000 16-C.P. lamps can be run. A station designed for 20 such engines would require no special engineering skill, except as to the supply of its fuel and the removal of its ash. Imagine a station equipped with 20 such engines capable of simultaneously developing 20,000 H.P. To each engine let there be directly belted two 5,000-light (250,000-watt) dynamos, each dynamo operating at 5,000 volts E.M.F., there will then be 40 dynamos, from each of which a single feeder connected through a modern switchboard will be led out. Each feeder, when fully loaded, will then carry 50 ampères at, say, 5,500 volts. We estimate that 40 such feeders can be made to deliver a maximum load of 100,000 16-C.P. lamps, and 10,000 to 15,000 H.P. of motor power.

It can be shown that with a potential of 5,000 volts, the cost of copper mains for distances not exceeding 2,000 yards from a station is comparatively insignificant, so that if this voltage be applied, it will greatly reduce the outlay for and care of the underground work.

Thus far our problem is simply one depending upon the necessary capital forthcoming to construct the work and purchase the apparatus. The question next arising is, how shall the 5,000-volt alternate currents generated be safely transformed? The first thing to do is to lease a number of cellars, say 10, lying at the heart of the electric service. Each cellar is to be entered by two or more feeders; connected to the feeders by and through proper switchboards are large transformers of at least 50,000 watts or 1,000 lights capacity each. If the cellar or sub-station is to furnish its surrounding territory with ten thousand lights, ten transformers of one thousand lights capacity each would be installed; the primaries of these transformers to be connected to a common feeder entering the sub-station, whose duplicate is at hand in case of accident to the mains. From the secondaries of these sub-transformers, circuits at 1,000-volt potential lead through a switchboard to the service mains.

The advantages of this method of distribution over the ordinary single conversion method is very great; not only is there a separate transformer insulation between the station and the consumer with abundant opportunity to test and keep clear the underground work, but as the load upon the station is indicated at each sub-station, the attendant can insert or remove the transformers from circuit according to the variations of load. As the efficiency of the system will depend largely upon the efficiency of the apparatus exterior to the station and to some extent upon the efficiency of these sub-station transformers, it may be well to give a few figures on the losses found in electro-magnetic apparatus, such as transformers or motors when they are actuated by alternate currents.

Neglecting the losses that occur in large masses of metal carrying alternate currents—such as thick copper mains—it can be shown that alternate currents principally waste energy when they are called upon to produce strong magnetic forces, and that these losses are a serious matter unless proper precautions are taken to avoid them.

An extended series of tests on many samples of the best steel and iron determine that when the magnetisation exceeds 30,000 C.G.S. lines per square inch, the losses in the iron increase much more rapidly than the magnetisation obtained, and that the most economical point to work good iron magnetically is at a loss of about 1 watt per lb.; this, of course, is not an inflexible rule, but is a safe and fairly accurate conclusion. Under this rule, therefore, if a transformer or motor magnetised to the proper degree, has a flux-conveying core that weighs 100 lbs., then so long as it is in operation it will continuously lose 100 watts. If the core magnetised weighed 250 lbs., there would be a continuous waste of 250 watts, &c.

Let us apply these figures to the efficiency of these sub-station transformers.

The core of a twenty-light transformer weighs from 40 to 100 lbs., and wastes from 45 to 120 watts, or at least two watts per lamp.

A one hundred light transformer core weighs 100 lbs. and wastes continuously 100 watts, or one watt per lamp.

A three hundred light transformer core weighs 200 lbs., and has a minimum loss of 200 watts, or ·66 watts per light.

A one thousand light transformer core will lose about 500 watts or ·5 of a watt per light, so that the iron loss in ten sub-station transformers of 1,000 lights capacity each, or 10,000 lights capacity total, would be 5,000 watts, or 1 per cent. of their output. The loss in the copper circuits of these transformers would not exceed 1 per cent., and thus the total efficiency of the large sub-station transformers would be, approximately, 98 per cent. at full load, and 93 or 94 per cent. at one-quarter load.

There is no particular difficulty in building these large transformers to have this very high efficiency.

Finally, in summing up the subject, we wish once more to emphasise the complete flexibility of the alternating current system of light and power distribution. In the station the advantages of the alternating system at once make themselves apparent by the simplicity of equipment.

Granting that the efficiency of the alternating current dynamo does not exceed that of the direct current machine, it is at least fair to assume them on a par. The number of feeders are few, their size small, and the consequent first cost insignificant, as compared with feeders for direct current to transmit the same amount of energy.

Aside from first cost, the cheap maintenance of subways should be considered. The efficiency of the system from station to consumer may readily be 90 per cent. for very considerable distances if properly designed.

Lastly, to be considered, is the complete adaptability of motors on feeders furnishing current at great distances from the source of supply, which with direct currents is an impossibility, for if direct currents were used the E.M.F. necessary to run the motors at would be up in the thousands of volts, in order that the cost of the mains should not prohibit their being laid. This is a higher E.M.F. than can be used with commercial success, and is also attended with great danger.

On the other hand, with the alternating current the transmission of energy may be at high voltages, and its use as light and power may by transformation be at a low E.M.F.

as 100 volts. Consequently we must use the alternating current system where any considerable amount of light and power are required.

NOTE.

The principle of using a condenser to neutralise a self-induction is of course old, having been used by Maxwell. There are several reasons why it has not been used in the way mentioned above. 1st.—That many electricians, such as Le Blanc and Swinburne, considered that the loss from hysteresis would be too great to be commercially practicable. 2nd.—The difficulty in the manufacturing of condensers which have no leakage, and will stand 1,000 volts day in and day out for an unlimited time without getting hot, breaking down, or having a dielectric thickness of over 10-thousandths of an inch. 3rd.—The idea that the E.M.F. on the condenser must run up very high to produce the regular results. 4th.—That even with the condensered field the motor will not run well, as the current in the armature will lag.

As regards the first and second of these objections to an alternating field, I cannot do better than quote Mr. Kelly's note in the *Electrical Engineer*, as follows :—

The *Electrical Engineer*,
January 13*th*, 1892.

STANLEY AND KELLY'S ALTERNATING MOTOR: A REPLY TO MR. SWINBURNE'S CRITICISMS.

With your permission we would like to make a few remarks on the interesting comments by Mr. Swinburne in your last issue on our alternating current motor. As to hysteresis, we fail to see why this is more important in our motor than in any other in which the field is equally highly magnetised and the periodicity as great. With regard to danger from high potential, we think there is none. The E.M.F. on field and condenser does not need to exceed 750 volts, and both field and condenser can be effectually protected from contact. Besides, it must be borne in mind that if through any cause a shunt were formed around either field or condenser, say, by a human body, the potential would at once fall, as the balance would be destroyed.

Mr. Swinburne's suggestion of a double-winding for the armature is another instance of his well-known sagacity and foresight. As a matter of fact, we adopted a multiple winding months ago. We are not quite prepared to enter into a detailed description of our motor yet, but not even Mr. Swinburne has foreseen the number of difficulties we have met, and we are happy to say, conquered.

W. STANLEY, Jun.
JOHN F. KELLY.

In regard to the second, the production of such condensers has been made, thanks to the work of Mr. Le Blanc, and Messrs. Stanley and Kelly, a very easy matter, and such condensers work perfectly; they do not get hot, break down, or change their capacity, and they are very cheap.

As regards the fourth, it is easy to see the importance of the compensating winding. It takes nearly all the self-induction out of the armature, while if the strips of copper used are large enough, the increase of resistance in the armature is very small.

NOTE.—(The compensating winding is of course not connected in any way to the armature; it consists simply of a number of coils of low resistance wound in grooves in the face of the pole pieces, short-circuited on themselves.) It is chiefly in this point that the originality of the Stanley-Kelly motor consists, and it is this which gives it its value.

It is of course evident that by using this compensating winding a good synchronising motor may be made, for it is only necessary to start it by putting a resistance in the field, and when it comes up to speed, throwing over a switch so as to supply the field with a direct current supplied from a rectifying commutator on the shaft, the same as is used in self-exciting alternating current dynamos.

REGINALD A. FESSENDEN.

Fire on Board an Atlantic Liner.—On Monday last, says the *Daily Chronicle*, a fire broke out in the library of the Inman steamer *City of New York*, lying in Birkenhead Graving Dock. It is supposed that the fire was caused by electric wires, which run through cotton wool between some woodwork and the funnel of the vessel. Considerable damage was done to the fittings of the library.

NIAGARA THE MOTOR FOR THE WORLD'S FAIR.*†

BY PROF. JOHN TROWBRIDGE.

THE remarkable new developments in the subject of the transmission of power by electricity come from the employment of a high electrical pressure or voltage generated by a to-and-fro, or alternating current, instead of a direct current; and, strange to say, an apparatus which has long been used on professors' tables to illustrate the conversion of a low pressure current of electricity into a high pressure current has now come to have a great commercial value—this apparatus is the Ruhmkorff coil. In its elements it consists merely of two coils of wire entirely separate from each other, which are slipped on a bundle of iron wire which forms a core. If an alternating or rapidly interrupted current of electricity from a battery or a dynamo is sent through one of the coils, a current is generated by induction in the neighbouring coil. The pressure in this latter coil depends largely upon the number of windings in it. A pressure of only two units in the coil which is connected with the battery or dynamo, can be exalted to a pressure of 12,000 to 100,000 units in the independent coil, by properly increasing its windings. Again, if the sparks from a Leyden jar, which is charged to 100,000 volts by an electrical machine, should be sent through a coil of many windings; a neighbouring independent coil can be made to give a pressure of only four volts, with, however, a large current for an instant. The Leyden jar current is a very feeble one, although it has a high pressure.

If it were possible to direct a bolt of lighting through a coil of many thousand windings of fine wire, a neighbouring coil of few turns of coarse wire, entirely unconnected with the coil through which the bolt of lightning passes, could be made to furnish a current for an instant which would decompose water into oxygen and hydrogen, although this would have been out of the power of the original bolt of lightning. In this system of exalting the pressure by employing induction in independent circuits, for instance, between two coils slipped upon an iron rod or a bundle of wire, we have the modern transformer system, which marks a great development in the subject of the practical application of electricity. It will be noticed that we have a step-up transformer when we exalt a pressure of 4 volts to 100,000 volts, and a step-down transformer when we use a pressure of 100,000 volts in a fine wire coil to produce a pressure of 4 volts in a neighbouring coil of coarse wire. A dynamo therefore producing only a 1,000-volt pressure, and the dynamo ordinarily used to-day can safely stand this pressure, can be employed to send an alternating or pulsating current through the coarse coil which we slip upon our iron rod, and the fine wire coil of greater number of turns, which is placed near but unconnected with the coarse coil, can be made to give by induction a pressure of from 12,000 to 20,000 volts. This pressure can be transmitted over a fine wire 100 miles, passed through another fine wire coil upon an iron rod, and a neighbouring coarse coil can be then made to yield a lower pressure suitable for decomposing water, running an electric motor without burning it up, or doing any work which the generating dynamo at the sending end is capable of.

In 1883 the attention of mankind was directed to producing dynamos which would give the steadiest continuous current; to-day we are striving to produce dynamos which will give to-and-fro currents; for the success of the new method of transforming electricity from one pressure to another depends upon the fluctuation of a current, and not upon its steadiness. It may be said that our inventors unconsciously have been imitating nature; for every bolt of lightning is not one continuous discharge, but is an alternating current which pulsates to-and-fro ten or twelve times or even more in a millionth of a second.

The recent success in transmitting power over one hundred miles is due not only to the method of transforming a current of low pressure to a high pressure and then transforming back at the receiving end, but also to the invention of an alternating motor. At first sight it seems impossible that an

* Abstract of an article in the January *Chautauquan*.
† *Western Electrician*.

alternating current flowing through a dynamo could make the armature of the latter revolve, for the pole of the electro-magnets which attract the armature become alternating north and south poles, and apparently neutralise each other's effect on the armature. Here we are brought again to see an apparatus which has long been exhibited on lecture tables, developed into an important commercial engine.

Arago showed that a copper disc suspended by a thread above a revolving magnet would be dragged around by this magnet. Its motion was due to the reactions on the magnet of the currents formed in the copper by the motion of the magnet. Prof. Ferraris in Italy, and Mr. Tesla in America, showed that instead of rotating a magnet, magnetic poles could be formed at different points in a collection of electro-magnets by means of alternating currents in such a manner as completely to imitate a revolving magnet.

The copper disc would therefore follow the changing poles. Instead of a disc an armature consisting of copper rods was made, and the new alternating current motor sprang into existence. Its most striking peculiarity consists in its absence of brushes, such as are used on ordinary dynamos. Its armature, or revolving part, is practically a copper disc revolving under exactly the same conditions as in Arago's experiment. To this or to a similar alternating current motor we must look for aid in transmitting power over a wire from Niagara Falls to Chicago.

It is interesting to note that the conditions for the transmission of power by electrical means over long distances are closely analogous to those which are employed in long distance telephony. The transmitter is an alternating current machine operated by the human voice, and the telephone at the receiving end is an alternating current motor which impresses its motion upon the air and thus reproduces the speaker's voice four hundred miles away. In long distance telephony, too, the step-up transformer is used.

It seems to me undoubtedly true that a diminution in our coal supply would result in making the transmission of power from Niagara Falls to New York a success. Economically considered it would be cheaper for the directors of the World's Fair to obtain 5,000 horse power from coal at Chicago. The sublimity of the attempt, however, possesses its attractions. Mankind has often cast uneasy glances at these unemployed giants, waterfalls and tides, as if envying them their freedom. If we could make them store up their energy and hand it over to us we should no longer be compelled to delve in mines a mile under the earth for coal, and we could fold our hands while the water ran on and did our work.

When the storage battery was invented it was thought that the Niagara Falls had lost its freedom and would be immediately set to work. There was a period when the elation of mankind grew less and faith in storage batteries declined; for they were far from perfect and could not be relied upon. It was much as if the swift trotting horse had appeared before long experience had been obtained in training him and in properly nourishing him. The early experimenters endeavoured to drive the storage batteries too hard, and the battery broke down under severe usage. To-day the storage batteries are becoming a commercial success, and people understand better how to keep them in condition. There is therefore a possibity of employing them to convey a portion of the power of Niagara to Chicago. Let us see what this possibility is.

Roughly speaking, 6 horse-power can be stored in a ton of material, which constitutes the storage battery. The equivalent of 50 horse-power could be certainly carried in one freight car, and it would therefore require 100 freight cars to transport 5,000 horse-power from Niagara Falls to Chicago. The cost of the batteries would be in the neighbourhood of $2,000,000, and in order to maintain 5,000 horse-power in Chicago, relays of batteries would have to be employed. Against the expense of this method, we must place the cost of the high insulation of a line of 400 miles under a pressure of 20,000 volts. In both cases, neglecting the factor of sublimity, it would be more economical to generate the electricity at Chicago from coal by the ordinary method of employing a steam engine to drive a dynamo. Improvements in constructing high insulation wires and in transforming high electrical pressures to low ones, and *vice versâ*, may make a greater revolution in the subject than has been made since the first experiments of Deprez in 1882.

It is interesting to note, in connection with the plan of utilising the power of Niagara Falls, that some of our most thriving manufacturing centres are not located on water courses, and depend upon coal, and not upon water power. The cities of Fall River and New Bedford, in Massachusetts, are rivalling Lawrence and Lowell in the number of their spindles. Both can obtain their supply of coal by cheap transportation in vessels. The cost of regulating water power is a large item in the use of it, and steam is found to be more reliable and cheaper in many instances. There is no doubt that it would be more economical to generate 5,000 horse-power in Chicago by means of coal, than to attempt to transmit it from Niagara Falls. A great change, however, in our coal supply, would speedily turn attention to the immense waste of energy which is going on at Niagara Falls, and might convert New York State into a beehive of industries, and Chicago might then find its proposed experimental line of 400 miles of great value.

There is now an opportunity for a millionaire to provide the means of transmitting 5,000 horse-power or more from Niagara Falls to Chicago. He will certainly have his name inscribed in the temple of fame.

NEW PATENTS—1892.

969. "An improved brake for electro-motors or for machines driven by electro-motors." H. R. Low and W. B. CREIGH. Dated January 18th.

982. "Improvements in or connected with the manufacture or production of chloride of zinc and alkaline sulphates and of zinc and chlorine by electrolysis of solutions thereof." T. PARKER, A. E. ROBINSON and C H. PARKER. Dated January 18th.

1,038. "A new or improved manufacture of an exciting material for galvanic batteries." H. KOLLER. Dated January 19th.

1,041. "Improved means of generating electricity for buildings." S. J. ROLLASON. Dated January 19th.

1,061. "Improvements in bleaching and disinfecting starch and fecula by electrolysis." E. HERMITE. Dated January 19th.

1,096. "Improvements in electric signalling on trains." A. SHIELS. Dated January 19th.

1,125. "Improvements in or connected with the side and other lights of electric or other launches, or vessels." K. D. BOWEN. Dated January 20th.

1,141. "Improvements in dry electrical elements." C. VOGT. Dated January 20th.

1,143. "Improvements connected with electric elevators and motors." AMERICAN ELEVATOR COMPANY. (Communicated by Otis Brothers & Co., United States.) Dated January 20th. (*Complete.*)

1,145. "Improvements in the manufacture of siliceous insulating material for electrical and other purposes." H. A. WALKER. Dated January 20th.

1,147. "Improvements in telephones." H. E. NEWTON. Communicated by P. Rubbidge, New South Wales.) Dated January 20th. (*Complete.*)

1,163. "Improvements in connection with the brushes of electric generators and motors." J. YOUNG and R. SIMPSON. Dated January 21st.

1,185. "Improvements in stopping and starting pendulum clocks by means of electricity; the same applies to double pendulum movement as used in electricity meters." W. GREEN. Dated January 21st.

1,216. "Improvements in electric cut-outs." H. KORTEN. Dated January 21st.

1,243. "Improvements in magnetic compasses for use by night (on horseback)." J. J. STEWARD. Dated January 22nd.

1,254. "The automatic electric intermittent illuminating sign or lamp." F. J. JONES. Dated January 22nd.

1,298. "An improved table for telegraph instruments." K. V. MILLER. Dated January 22nd.

1,308. "Improvements connected with electric targets." J. F. WALTERS. Dated January 22nd.

1,313. "Improvements in electric motor cars." S. H. SHORT. Dated January 22nd. (*Complete.*)

1,337. "Improvements in brush-holders for dynamo machines." J. P. HALL. Dated January 23rd.

1,340. "Improvements in electrical switches and other apparatus for making and breaking contact." H. J. S. HEATHER. Dated January 23rd.

1,391. "Improvements relating to the coating of articles with a new metallic alloy by electro-deposition." THE LONDON METALLURGICAL COMPANY, LIMITED, and S. O. COWPER-COLES. Dated January 23rd. (*Complete.*)

1,396. "An automatic electric circuit breaker." A. EICHLER. Dated January 23rd. (*Complete.*)

1,402. "Improvements in heating by the electric arc, and in apparatus therefor." H. HOWARD. Dated January 23rd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1890.

17,863. "Improvements in portable electric lamps." M. P. HARDT. Dated November 6th. 8d. The lamp embodying the improvements chiefly comprises a wooden box containing a primary or secondary electric battery composed of flat rectangular cells, a lid which is hinged to the box and carries an incandescent lamp together with its circuit connections and guard, and a reversible holder attached to the sides of the box. 6 claims.

18,554. "Improvements relating to the fixing in insulating bases of blocks for connecting electrical conductors." H. J. PIERCE. Dated November 17th. 8d. Consists in forming the base, which may be of porcelain, glass, slate, china, or any other usual material, with recesses, slots, or undercut holes so made that the block may be slid therein and held thereby by the aid of one screw only screwed into the block transversely to the line of sliding of the latter in its recess in the block, so that either the point of the screw passing the block or the head of the screw lying over the block may lodge in a hole or recess in the block, and so prevent its withdrawal from the socket or recess in the base, the latter being also so made that the block may be removed after sufficient loosening of the screw without it being necessary to completely remove the screw from the block. 1 claim.

18,555. "Improvements in electrical switches." H. J. PIERCE. Dated November 17th. 6d. This invention produces a quick-break switch in which the making point of contact is at a different place from the leaving point of contact at both surfaces of contact. 1 claim.

18,557. "Improvements in electrical switches." H. J. PIERCE. Dated November 17th. 6d. Consists in making the contact bar or piece as or of a jointed or elbow-jointed lever, the inner part being fixed to the spindle, and the outer part hinged thereto, a spring being provided which tends to straighten out said parts or joints, the outer against a stop on the former, in readiness for making contact. Upon moving the handle to open the circuit, the outer or contact making end being retained by friction of the contact spring, is bent back and retained in this position during the movement of the contact bar until it reaches the end of the fixed contact, when the bar straightens under the tension of the spring, and produces a quick break in the circuit. 1 claim.

18,558. "Improvements relating to electrical pendants and other portable or movable electrical devices." H. J. PIERCE. Dated November 17th. 8d. The object of the invention is principally to provide for the automatic taking up of the wire when returning the device to or towards the rose or wall plate, or the like. A spring barrel is used for the purpose. 3 claims.

19,308. "Improvements in and connected with electrical distribution of power by alternating currents." J. SWINBURNE. Dated November 27th. 8d. Consists in putting condensers in shunt to the primary circuit. A condenser takes a current which leads relatively to the pressure, so that it counteracts the effect of the lagging current. For instance, in the case of the arc lamps, the current of 100 ampères may be regarded as compounded of a current of 33 ampères, in step with the primary pressure, and 95 ampères lagging a quarter of a period. A condenser of about 85 microfarads will supply the 95 ampère component, while the dynamos supply the 33 ampère component. One engine and dynamo is then enabled to supply the arc lamps. 6 claims.

20,102. "An improvement in dynamo-electric machines." A. S. BAXENDALE. Dated December 9th. 6d. Instead of arranging bobbins of insulated wire on a revolving armature, the inventor attaches such bobbins to oscillating arms, by which they are moved to and fro in magnetic fields. 1 claim.

20,379. "Improved underground electric conduit." J. P. BAYLY. (A communication from abroad by C. E. Loth, of New York.) Dated December 13th. 8d. The main object of the invention is to provide for the laying of the wires in a manner such as it will be possible to dispense with insulating covers except at, or in close proximity to, the points of support; to provide for the gathering and removal of all water which would otherwise collect in the conduit; to provide for the imparting of a uniform and proper tension to the wires; to provide for the drawing of the wires from point to point within the conduit; to protect linemen from injurious shocks while at work, and, finally, to provide for ventilating the conduit to avoid explosions of sewer gas. 10 claims.

20,838. "A new or improved dry couple or element for electrical purposes." H. BIRKBECK. (A communication from abroad by O. Henrichsen, of Copenhagen.) Dated December 20th. 6d. Has zinc and carbon electrodes, whereof the carbon electrode is surrounded by pyrolusite and graphite mixed in suitable proportions. A solution of sal ammoniac is used as the exciting liquid, and is formed into a soft paste by the admixture of a suitable quantity of silicious marl. Over this paste, which surrounds the whole zinc electrode, is placed a firmer layer consisting of a mixture of gypsum and silicious marl or earth saturated with exciting liquid. Over this firm layer is arranged a very porous layer of sawdust and powdered peat, or of other similar material, while a covering layer of gypsum dissolved in water is placed over the latter. Before pouring out this last solution a valve consisting of a tube of straw, or the like, having an opening of about 5 mm., is fixed to a small disc of paper pulp or cardboard, and is placed upon the powder and dust, being held in position by means of gypsum. The final closing layer is composed of a mixture of asphalte and resin, or of any other similar material. 1 claim.

21,147. "Improvements in or relating to the insulation of electrical conductors." A. J. BOULT. (A communication from J. B. F. Frédureau, of Paris.) Dated December 29th. 8d. Relates to electrical conductors such as wires, cables, or tubes insulated on the outside in bundles, and each separately by means of a natural or artificial silicious substance such as ardoisite schist, silicious sand, asbestos, mica, or the like either in a pulverised or solid state in the shape of discs, spherical caps, or other pieces of any suitable form terminating at either end in a spherical surface, one of which is convex and the other concave, such pieces being either hollow or solid, and perforated with one or more openings for the passage of the electrical conductors, and in certain cases of natural or forced currents of air. 2 claims.

21,224. "Improvements in the construction of the "spring jacks" or "jack knives" and their stoppers or contact plugs of commutators for telephonic circuits." C. D. ABEL. (Communicated from abroad by Société Générale des Telephones and L. A. Berthon, both of Paris.) Dated December 30th. 8d. Has for its object to reduce to a minimum not hitherto attained, the thickness of the bands of spring jacks and the dimensions of the stoppers or contact plugs. 8 claims.

CORRESPONDENCE.

Overhead Wires.

Permit me to express regret that you, as representing the interests of the electrical trade, should assume, to quote your own words "that the position of the Electrical Trade Section of the Chamber of Commerce will suffer considerably in the estimation of engineers, who are not members of it, if there is ground to suppose that it acts hastily and without due consideration." I should therefore be glad to have the opportunity, on behalf of the Electrical Trades Section of this Chamber, of making some comments on the leading article on overhead wires in your issue of the 15th inst, and in which you deprecate our action in the words just quoted. In that article you refer to Mr. Crompton's interpretation of the letter addressed to him by the Board of Trade, that intrepretation being that overhead conductors "can only be used as a temporary arrangement and that all permanent conductors must be laid underground." Such a limitation would, I claim, alone authorise the action which has just been taken and a complete justification can, I think, be put forward if such were needed, by giving a full quotation from the communication (No. 1.) referred to, of which I enclose a copy, and which I shall be glad if you will publish in conjunction with this explanation. In that letter the Board of Trade say "they are unable to approve of any system in which overhead wires are used as a permanent arrangement and that they would not be prepared to give *even a temporary approval* to a system in which such wires were used unless they were erected in strict accordance with the regulations" of their department. Surely, this letter is capable of only one construction, viz., that the Board of Trade had sternly set its face against the principle of overhead wires. Further, they emphasise their decision that they would not approve of "any system" of overhead wires, by saying that they would not even give a "temporary approval" to such a system, unless carried out to their satisfaction. It is true that this letter was sent in reply to Mr. Crompton's, which contained a description of the system proposed to be adopted for the electric lighting of Chelmsford, but there is absolutely no reference of a local character therein. The Board of Trade, no doubt, and rightly too, base their decisions in such questions on the interests of public safety, the weightiest of all considerations. But there is no reason given in the letter referred to why overhead wires should be prohibited in the neighbourhood of Chelmsford, except the very general one that they would not sanction "any system." If I might so far trespass on your space, I would ask you to publish the enclosed copy of the letter (No. 2.) of the 4th inst., to which you refer, so that the two letters may be contrasted side by side. In this last letter the Board of Trade now say (*after* the wide publicity given to our memorial) that they "will continue to consider each application on its own merits." I would ask your readers whether there is anything in the letter (No. 1) to Mr. Crompton to show that the Chelmsford application had been considered on its merits? In contrasting the two letters, I would merely mention, for the information of your readers, leaving them to draw their own conclusions, that there can be no doubt that the Board of Trade were fully acquainted with the text of our memorial, as several of the signatories sent their copy of the memorial in error direct to the Board of

Trade instead of returning it to this office, and further, it is reasonable to suppose that the Board of Trade had ascertained from the trade papers that the action which we were taking was being most influentially supported by every branch of the profession in all parts of the kingdom.

But I am mainly concerned in showing, in refutation of your criticisms, that the action initiated by this Chamber was, under the circumstances, absolutely essential and, from from this point of view, I may add that it still remains to be seen whether a similar memorial may not be necessary in the future, in spite of evidence that the memorial has, by anticipation, accomplished some of the work for which it was intended. One object of the memorial was to induce the Board of Trade to recognise that overhead wires are not necessarily and invariably dangerous to human life when proper care is exercised in their manufacture and erection. The Board of Trade have still not recognised this, as is proved by their letter of the 4th inst.; and while no complaint can be urged against supervision in each particular case in the interests of public safety, it will not, I hope, be regarded as an unworthy suggestion if I point out that the Board of Trade have still reserved to themselves the right to uphold the principle that overhead wires are a public danger, by exercising this power in an arbitrary manner.

I hope, sir, that I have succeeded in proving that the action of the Electrical Trade Section of this Chamber was not only far from ill-advised but absolutely necessary, and that the strong expression of opinion which was obtained was sought, not in the interests of any particular branch of the trade, but in the interests of the whole electrical industry of the United Kingdom, which the Section so fully represents. That the action was called for, that it was much appreciated, and that it has by its success proved its *raison d'être*, the numerous letters on the subject which I have received, and the signatures to the memorial itself, amply testify.

Trusting that you will find space to publish this in your next issue, and thanking you in anticipation.

Keuric B. Murray, *Secretary.*

January 28th, 1892.

No. 1.

[COPY.]

Assistant Secretary, Board of Trade
(Railway Department), London, S.W.

CHELMSFORD ELECTRIC LIGHTING LICENSE, 1890.

SIR,—With reference to your letter of the 28th ulto., containing a description of the system of supply proposed to be used for the purposes of the above-mentioned license, I am directed by the Board of Trade to inform you that they are unable to approve of any system in which overhead wires are used as a permanent arrangement, and that they would not be prepared to give even a temporary approval to a system in which such wires were used, unless they were erected in strict accordance with the regulations of this department.—I am, Sir, your obedient servant,

R. D. HERRINGTON.

No. 2.

[COPY.]

Board of Trade (Railway Department), London, S.W.
January 4th, 1892.

GENTLEMEN,—With reference to the letter addressed by your firm to the President of the Board of Trade, urging that this department should not lay down as a settled principle that no overhead conductors for the supply of electric energy should be allowed, but that in rural districts, at least, the circumstances of each particular case should determine whether overhead work should or should not be sanctioned, I am directed by the Board of Trade to say that your letter appears to have been written under a misapprehension of the practice of this department.

The Board of Trade are of opinion that as a general rule the use of overhead wires is accompanied by many disadvantages, both as regards the safety of the public, and the efficiency of the supply of energy; and they think it is most desirable that mains for the supply of energy under provisional orders or licenses should, wherever practicable, be placed underground.

They have not, however, laid down any absolute rule that overhead wires shall in no case be employed; and while they have declined in the absence of any special circumstances, to approve of a system in which the use of such wires was contemplated as a permanent arrangement in the central and populous portions of a town, they have on various occasions where the circumstances appeared to justify it and the local authorities approved, authorised the employment of overhead wires in rural districts, or the outlying and less populous portions of towns.

The Board of Trade see no reason to depart from the practice they have hitherto adapted of considering each application for permission to use overhead wires on its merits, having regard to the special circumstances of the district, and they will be prepared to authorise the use of such wires in any case in which they are satisfied that the interests of the public require it.—I am, gentlemen, your obedient servant.

(Signed) HENRY G. CALCRAFT.

Wiring of Houses for the Electric Light.

In your impression of the 29th inst. you print an article dealing with this subject, with reference to which I should like to make a few remarks. I certainly think with the writer, that even amongst contractors of high repute the idea exists, that running wires for the electric light is mere labourers' work and does not come within the pale of *skilled* labour. It is greatly due to this false impression that we have such a considerable number of failures, and such a vast amount of inferior work. The labour is undoubtedly cheaper, and, perhaps, if well supervised, might be almost as efficient as the skilled; but experience of contractors tends to show how loose and indifferent is their system of supervision; how little attention they, as a rule, pay to the wiring details of an installation compared with the amount spent in the choice of artistic fittings, or to such parts of the work as will perpetuate their name. The introduction of beautifully moulded casing, artistic switchboards, and elaborate electroliers are undoubtedly essential, but it is not right that he should devote so much of his attention to these secondary considerations, to the exclusion of such details as the making and insulating of joints, &c., which, though they may never be seen, are infinitely more important than these artistic elaborations.

The route of wires should certainly be visible at every point, and if the casing is painted on paper to accord with that used in the room, it should satisfy the most artistic eye. It is a great mistake, and one which appears to be gaining ground, to allow these false, fastidious ideas of decoration to outweigh, and to swamp those of practical utility. For it is not the decorative beauty displayed in any installation which will make that installation a success; it might indeed make it "a thing of beauty," but the "joy for ever" rests entirely with those practical considerations of jointing, insulation, and arrangement of cut-outs which, though rarely, *if ever*, seen by a fire inspector, plays such an important part in electric lighting.

And anent these inspectors, I would reiterate the remarks made in my former letter, that such a state of things is deplorable. Surely it is high time these fire rules were revised and made more practical; at present their construction is most ambiguous and they can always be read from a contractor's, and a consumer's point of view. I maintain that they should be made more decisive and practical, and that their inspectors should be technical men, capable of forming *their own* opinion. If this was done it would tend to reduce to a minimum those failures in the electric light which do so much to injure its reputation, and retard its progress.

W. J., *N.E.R.*

February 2nd, 1892.

Electric Organ Control.

In reference to Mr. A. E. Conti's letter in your issue of January 29th. Lest it should cause confusion it is perhaps better for me to say that my system is entirely different from the Genoa system mentioned. My advice was recently asked as to the reconstruction of one of the instruments named by Mr. Conti and in examining the organ I found it, though having several improvements, to be constructed generally upon the old lines. Though 30 Leclanché cells were used (which I was told frequently needed attention) the action was no quicker than an ordinary pneumatic, while it was (especially as regards the stops and pistons) far less certain. Very rapid repetition was an impossibility.

This action shows great ingenuity, but more on the part of the organ builder than on that of the electrician. No steps have been taken to avoid self-induction, or to comply with several of the well-known magnetic laws.

Robert Hope-Jones.

February 2nd, 1892.

CRYSTAL PALACE ELECTRICAL EXHIBITION, 1892.

AT the end of this week the Crystal Palace Exhibition may be fairly treated as a representative collection of electrical apparatus and machinery; and although there are still one or two ugly features in the way of disordered exhibits, they bid fair to be remedied before Saturday. It would be a pity if it were otherwise, for on the occasion of so important a function then destined to take place, it behoves each exhibitor to be in a fit state to receive company. The exhibition has now been opened four weeks, but the progress which has been made during that period is by no means remarkable, indeed, so slow has the work proceeded that one is driven to the conclusion that exhibitors were showing little energy in putting their exhibits in order. We do not assert that this is actually the case, but it certainly is unsatisfactory to find a difficulty in walking through the machinery room, some three weeks after the formal opening.

To obtain the best impression of the exhibition, one must visit the north and south naves in the evening, when each stand contributes its quota of light to the general brilliancy. And yet the effect is not a great white light shining on an unprotected eye. There is a wonderful unanimity in the use of shaded lights; and one might go from one end of the naves to the other, finding scarce a single lamp which destroyed the general harmony.

As a spectacular effect the screen of incandescent lamps is a failure. Although it is stated that the screen is only lighted at certain times, the scale of operations led one to expect a little better display.

Electric Light in Places of Worship.

There can be no doubt that hitherto there has been great conservatism in the adoption of the electric light in places of worship, but for this slow growth there are many reasons. Perhaps the chief is, that it seems scarcely feasible to have a special plant, however small, to be run during the evening services, which in most places are seldom held more than twice a week. With a central station in the neighbourhood of churches and chapels, however, the extra cost of the electric light ought not, when the advantages are considered, to form a serious objection. St. Jude's, Kensington was, we believe, the first church in London to adopt the electric light from a central supply station, and though installations are to be found in most London districts, the number of churches lighted is few. A few places of worship in the provinces are lighted, the largest, perhaps, being Durham Cathedral, the supply of electricity in this case being manufactured under the building. It is satisfactory to note that, however poor the demand has hitherto been, attention has been devoted to the electric fittings best suited to ecclesiastical buildings, and when the demand does arise, makers of fittings will be found competent to arrange lamps to advantage. To show that this is the case we draw our readers' attention to an illustration of Messrs. Benham and Froud's exhibit, which shows the arrangement of the electric light in the chancel of a church. The fittings, while designed with taste, are not ostentatious, but fit in with the surroundings. It is this fact

which accounts for the fittings not being very prominent in our illustration; having regard, however, to the circumstances under which this class of lighting would take place, there would perhaps be little gained by making the lamps too conspicuous.

Domestic Electric Lighting.

We illustrate a fitting taken from the "Solar Room," a dining room, Italian in style, to represent method of lighting same. The lights are designed to illustrate the solar system, the centre light the sun, and the brackets the planets. The pendant, which is of wrought iron, forged and riveted together in all parts, and brightened and polished, supports a dome light, covered with sheets of ivory fastened to ribs.

The polished iron fittings were specially designed for this Exhibition by Mr. W. Brainbridge Reynolds, and have all been manufactured by Messrs. Rashleigh Phipps and Dawson, at their Art Metal Works in Stanhope Street, Euston Road. We give a corner in one of the rooms fitted by the same firm.

A Large Electric Light Plant.

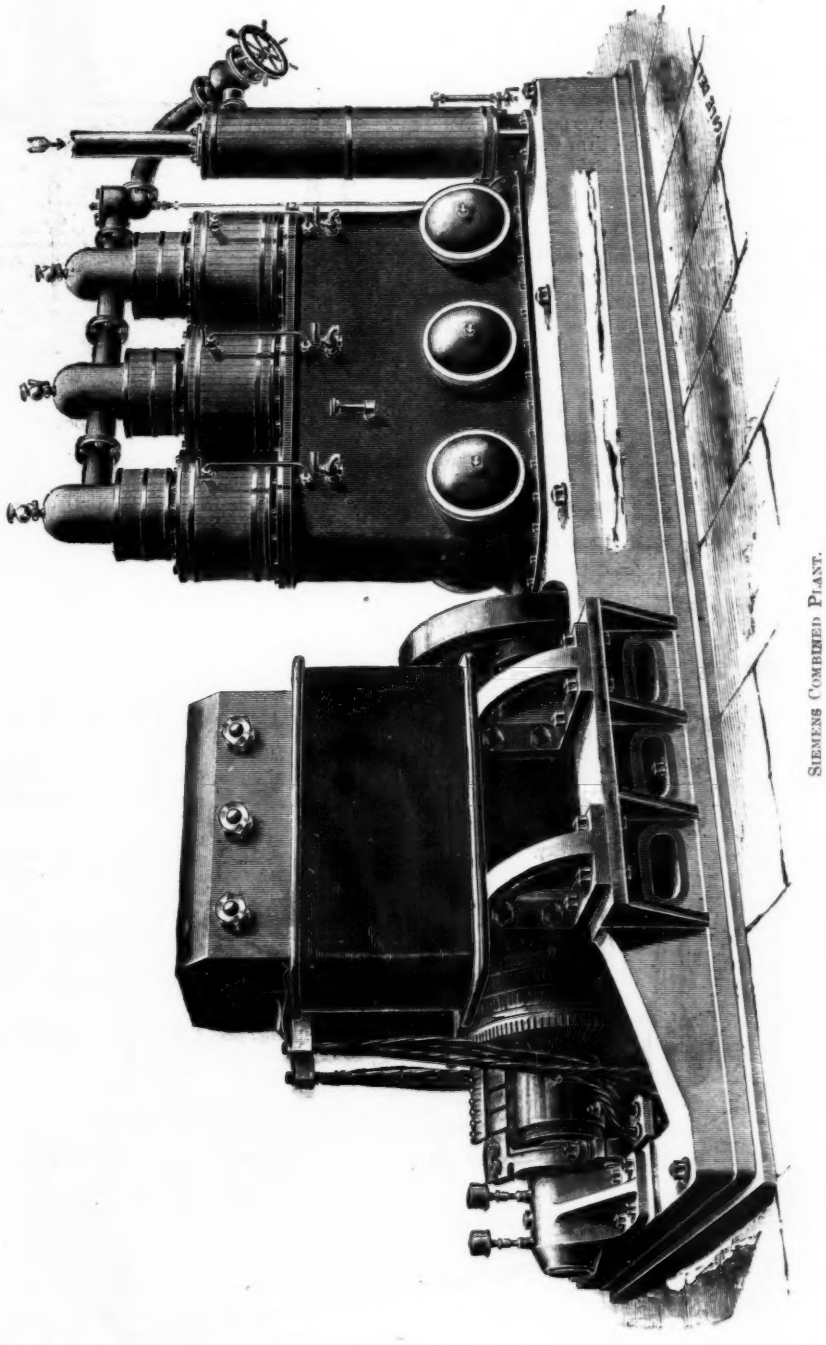
Perhaps the most interesting combined plant, certainly the largest, is the dynamo coupled with a Willans engine shown by Messrs. Siemens Brothers and Company. This plant did excellent work at the Naval Exhibition, and is similar to if not one of the same machines bought by the St. James's Electric Light Company for their new station.

The shade is surrounded by a moulded ring of forged iron, having upon it twelve Limoges enamels, hand painted, representing the signs of the Zodiac. The three scrolls which suspend the same have straps of wholly forged fruit, being pomegranate, orange and lemon, conventionally treated. Above the dome is a light temple-shaped construction of three forged open columns, which carry wires down to shade lamps supporting scroll work. Within the temple-shaped construction is a winged figure of a youth with a torch, in bronze and covered with gold, representing light. Above the figure is a sphere with rays representing the sun. The brackets are of forged iron, polished, and support spheres of ivory, engraved with the names of the planets, and supporting pendant lanterns, glazed with transparent plates of ivory, one face of which has upon it a figure representing the god or goddess of its respective planet.

The engine is one of Messrs. Willans and Robinson's high speed, numbered on their list as "I. I. I." It has three cranks at 120 degrees apart; three low-pressure cylinders 20 inches in diameter; three high-pressure cylinders 14 inches in diameter and a 9-inch stroke. The standard speed is 350 revolutions. The dynamo is of the two-pole inverted type, with a capacity of 1,500 ampères at 120 volts. Sufficient margin is left, however, for increasing this load 20 per cent. Advantage was taken of this at the recent Naval Exhibition, not the least overheating being apparent. Perhaps a few details regarding the construction of these dynamos may be of interest. The magnet limbs and yoke piece are constructed out of solid forgings of wrought iron, supported by gun-metal brackets bolted to the cast iron combination frame allowing sufficient space between the frame and magnet to prevent as much as possible any magnetic leakage.

Each magnet bobbin, which is complete in itself, can be lifted off by a special arrangement of shackles at each end. The solid gun-metal terminal blocks are mounted on the top cheek of each bobbin, and connected to the brush holders by flexible conductors of large section, capable of carrying the whole current given out by the dynamo. Each block is connected to the corresponding brush holders by two cables having a total cross-sectional area of 1·6 square inch. The armature is the usual Siemens drum pattern, built up of soft iron discs and stranded bars. The diameter is 24 inches, and it is mounted on a 6-inch steel spindle 7 feet 2½ inches long, one end of which is provided with a solid forged half-coupling for bolting to the corresponding half on the engine crankshaft. The brush holder spindles or rocking bars are supported by a cast iron ring from which they are insulated, and the brushes are adjusted by means of a very neat form of worm and wormwheel arrangement. Each spindle carries three brush holders, each of which is provided with a massive brush for collecting the current from the commutator. There are therefore six brushes in all, or three on each side of the commutator. The brush holders are fitted with hold-off catches. The commutator is 12½ inches in diameter, and has a bearing surface 9 inches long. The sections, of which there are 72, are of hard drawn copper, and are insulated with mica. The dynamo complete has a weight of 13¼ tons.

During the Naval Exhibition exhaustive tests were carried on these coupled plants, and the combined efficiency was found to be 84 per cent. at full load.



SIEMENS COMBINED PLANT.

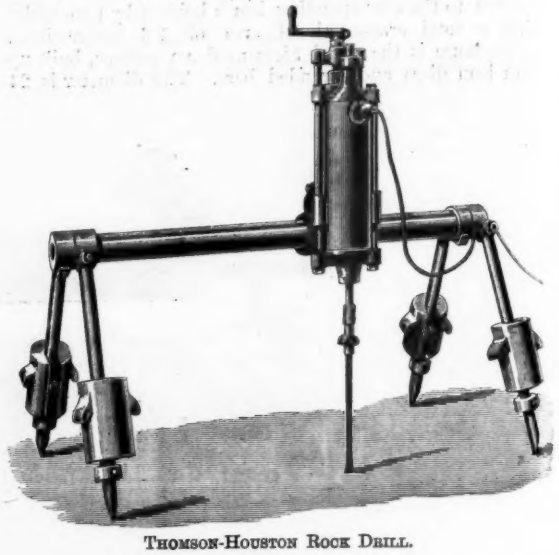
Ship Lighting Plant.

As regards the collection of ship lighting plant at the exhibition, we may say at once that it is remarkable. There is much competition existing nowadays as to who shall do the lighting of ships, and we may go so far as to say that competition is responsible for a good deal of inferior work. That immorality lurks in the lowest tender, is, or was apparent in this form of lighting. However, we are not going to discuss the question—at the present we are simply called upon to

describe a set of ship lighting plant made by Messrs. Siemens Bros. Our illustration shows a P. & O. set. A Tangye compound vertical engine, coupled with the usual ship dynamo is estimated to give 40 actual horse-power at 200 revolutions with 90 lbs. of steam. The dynamo is compound wound with the usual bar armature. It is capable of giving 220 amperes at 105 volts. The weight of the combined plant is a little under 7 tons. The wiring usually employed is the single wire system; instead of using branch wires for the lamps single wires are taken from distribution boxes. The circuits are divided into several, the police circuit, engine-room circuit—these burning night and day—and the saloon and cabin circuits. The usual number of lights on a P. & O. boat is about 400 16-C.P. The total number of ships lighted by Messrs. Siemens is 200, of which 40 are P. & O. and 20 Royal Mail. In addition, many war vessels have been fitted for the home and foreign governments. An instance of the work carried out by this firm was the ship, *Normannia*, owned by the Hamburg-American Company, which, with 960 lights, was fitted up in 8 weeks.

Drilling by Electricity.

In the many applications of electricity, we venture to think that none will fill a more useful purpose than the electrically controlled drill, and it does not need the gift of prophesy to predict that before long it will be in universal use. Hitherto these drills have not been adopted to any great extent in this country, but it is only necessary for their record of good work to be known for them to be largely adopted. The Laing, Wharton and Down Construction Syndicate, which, by the way, must not be confounded with the Bond Street establishment, show at their stand in the Entertainment Court a Van de Poele rock drill which is claimed to bore a hole in hard granite 2 inches in diameter,

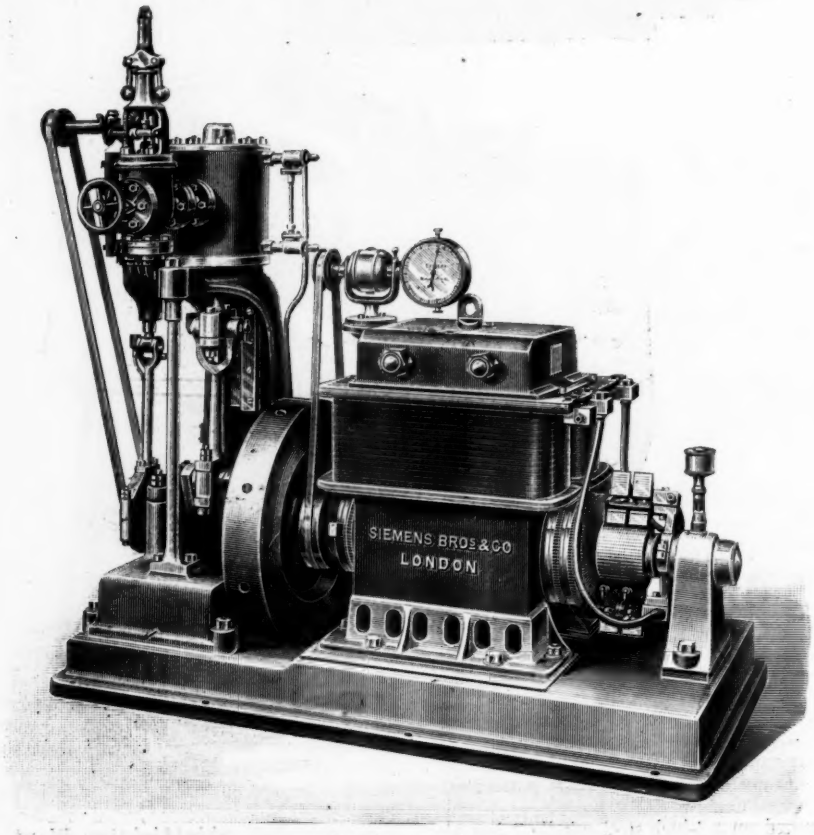


THOMSON-HOUSTON ROCK DRILL.

at the rate of 2¼ inches a minute. However this may be, the accounts from America certainly show the machine to be one of remarkable efficiency.

In weight these drills are stated to be very nearly equal to similar machines of the compressed air or steam type. In efficiency, however, they surpass those machines, and consume power as follows: Type E consumes 2 to 2½ I.H.P.; type D consumes 1½ to 2 I.H.P.; type C consumes 1 to 1½ I.H.P. The makers state that these figures are about a quarter of the power used for steam or other drills.

Perhaps the largest contract ever carried out by the aid of this drill is the one for deepening the bed of the Mississipi. American contemporaries state that the contract required that as many holes as were necessary should be drilled in the limestone rock to a uniform depth of 4 feet. The holes were made 1¾ inches in diameter at the top and 1½ inches at the bottom, drills of three different lengths being used. Work was begun on October 23rd, and on December 19th 941 holes had been drilled, many of them exceeding by two or three inches the specified depth. An average of 3·6 feet per hour for each drill is given, which is very creditable.



SHIP LIGHTING.